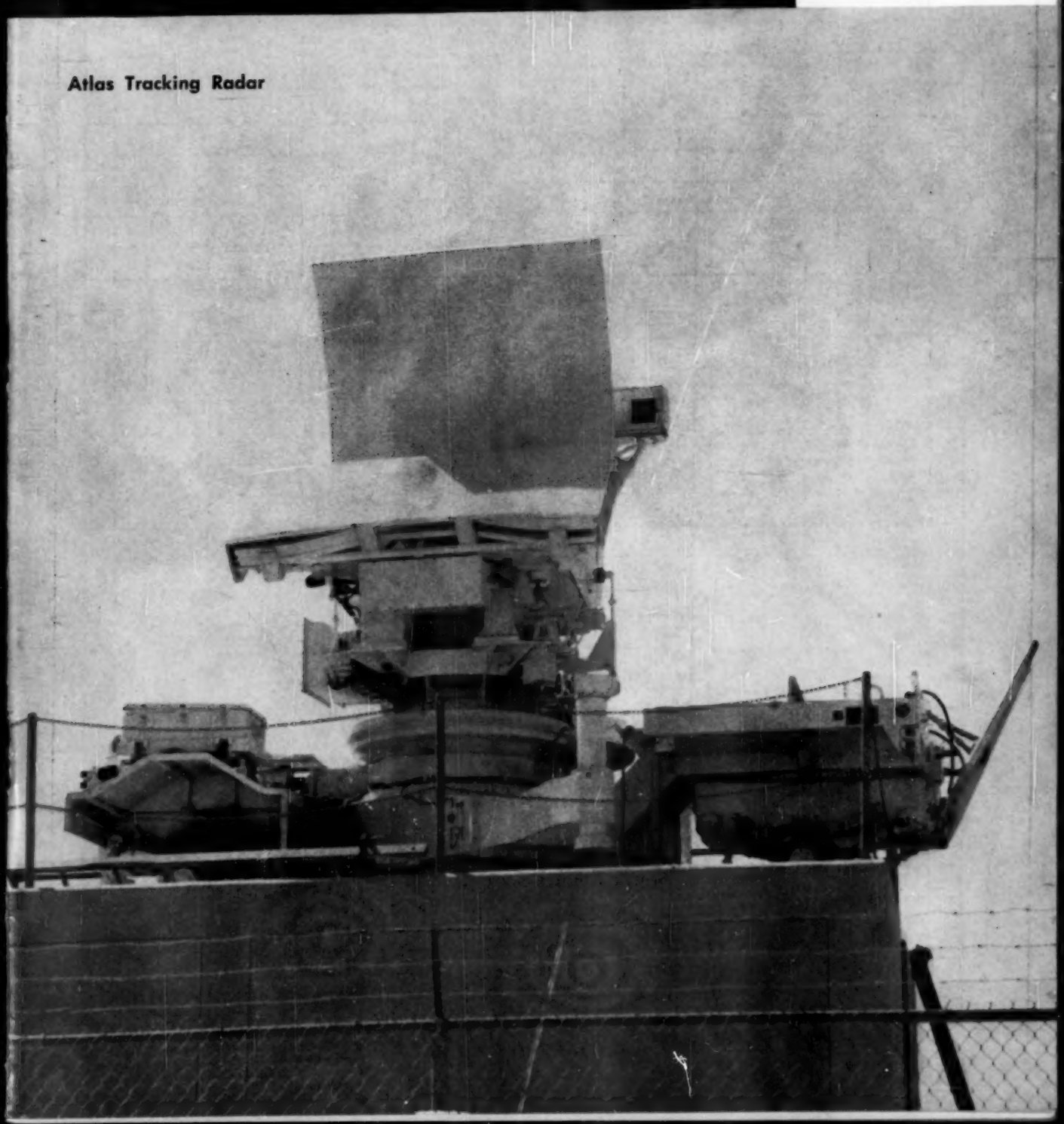
April 28, 1958

Aviation Week

Including Space Technology

GE-Burroughs Guidance Aims Atlas Missile



Atlas Tracking Radar

1951

1951 — First lightweight all-metal anchor nut

1952 — First narrow lightweight gang channel

1952

"The Most Copied Nut In The World"

1953 — First narrow lightweight floating anchor nut

1954 — First miniature anchor nut

1954

1955 — First miniature floating anchor nut

1956 — First deep counterbore floating anchor nut

SETTING STANDARDS OF PROGRESS

1956 — First internal/external wrenching hex nut

1955

1956

1956 — First lightweight A-286 corrosion-resistant steel anchor nut and hex nut

1957 — First complete line of NAS low-height nuts with thread relief

1957 — First lightweight high tensile 12 pt. nut

KAYLOCK

All-metal self-locking nuts ®

'symbol of leadership'

KAYNAR MFG. CO. INC. has become the world's leading manufacturer of lightweight all metal self-locking aircraft nuts.

- *All metal, rugged one piece construction*
- *Highest strength, lightest weight, lowest height*
- *Uniform locking torque* • *"Infinite" re-usability*

Kaylock Nuts conform to all Air Force-Navy standards: AN363, AN364, AN365, AN366, and the new low height lightweight National Aircraft Standards.

Kaylock Nuts available in steel or A-286 corrosion-resistant steel for use to 1200°F.

Trade Mark

KAYNAR MFG. CO. INC., KAYLOCK DIVISION Dept. A5-
Box 2001 Terminal Annex, Los Angeles 54, California
Canadian Distributor: Abercorn Aero Ltd., Montreal, Quebec

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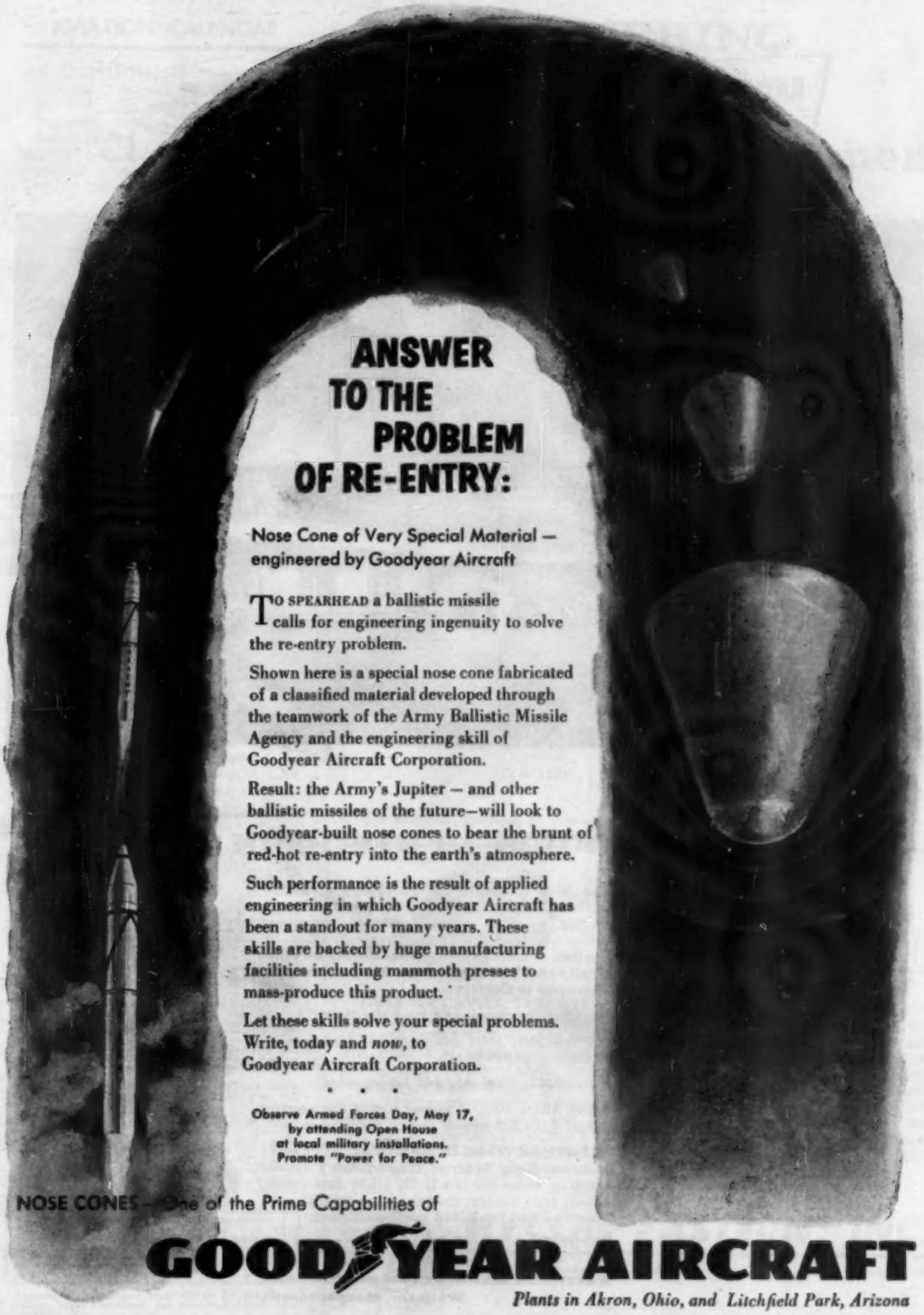


ANSWER TO THE PROBLEM OF RE-ENTRY:

Nose Cone of Very Special Material — engineered by Goodyear Aircraft

TO SPEARHEAD a ballistic missile calls for engineering ingenuity to solve the re-entry problem.

Shown here is a special nose cone fabricated of a classified material developed through the teamwork of the Army Ballistic Missile Agency and the engineering skill of Goodyear Aircraft Corporation.

Result: the Army's Jupiter — and other ballistic missiles of the future—will look to Goodyear-built nose cones to bear the brunt of red-hot re-entry into the earth's atmosphere.

Such performance is the result of applied engineering in which Goodyear Aircraft has been a standout for many years. These skills are backed by huge manufacturing facilities including mammoth presses to mass-produce this product.

Let these skills solve your special problems. Write, today and *now*, to Goodyear Aircraft Corporation.

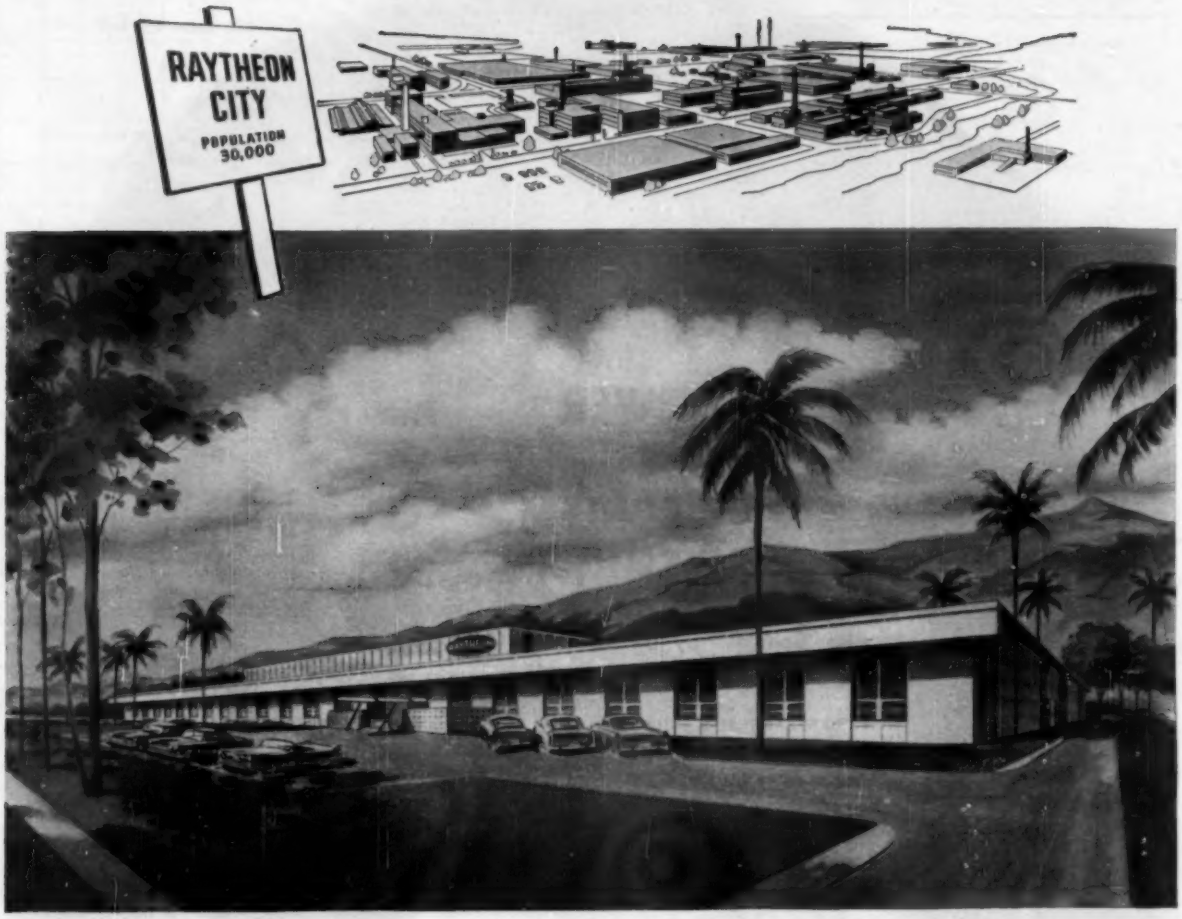
• • •

Observe Armed Forces Day, May 17, by attending Open House at local military installations. Promote "Power for Peace."

NOSE CONES — One of the Prime Capabilities of

GOODYEAR AIRCRAFT

Plants in Akron, Ohio, and Litchfield Park, Arizona



NEWEST ADDITION TO RAYTHEON "CITY"

Increases company's engineering space to 903,000 sq. ft.

Raytheon's brand new laboratory at Santa Barbara, California, is devoted to advanced engineering in radar, countermeasures, communications, infrared. It's another extension of Raytheon "City"—the booming electronics community that has grown from Massachusetts to Tennessee to California.

Here are the company's vital statistics:

POPULATION: 3,000 scientists and engineers; 30,000 employees in all.

BUILDINGS: 26 plants and laboratories.

WORK AREA: 903,000 square feet of engineering space; 4,104,827 square feet of total space.

ACTIVITIES VITAL TO NATIONAL DEFENSE: Missiles—Navy Sparrow III and Army Hawk; bombing radar for the B-52; DEW line radar; tubes, transistors; magnetrons, amplitrons, klystrons and backward wave oscillators.

REPUTATION: World-wide.

RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY
Waltham, Massachusetts

AVIATION CALENDAR

May 5-7—1958 National Symposium, Professional Group on Microwave Theory and Techniques of the Institute of Radio Engineers, Cubberley Auditorium, Stanford University, Stanford, Calif.

May 12-14—National Conference on Aeronautical Electronics, sponsored by Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 12-16—Airport Operators Council 11th Annual Meeting, El San Juan Intercontinental Hotel, San Juan, Puerto Rico.

May 14-16—Spring Meeting, Society for Experimental Stress Analysis, Hotel Manger, Cleveland, Ohio.

May 19-22—17th Annual National Conference, Society of Aeronautical Weight Engineers, Inc., Belmont Plaza Hotel, New York, N. Y.

May 20—Conference on the Economics of Research and Development, sponsored by the National Science Foundation, Shoreham Hotel, Washington, D: C.

May 21-22—Flight Safety Foundation, Inc., Regional Business Aircraft Safety Seminar, Palmer House, Chicago, Ill.

May 25-31—1958 Aviation Writers Assn. Convention, the Shamrock Hilton, Houston, Tex.

June 2-4—National Telemetering Conference, Lord Baltimore Hotel, Baltimore, Md.

June 4-5—West Coast Magnesium Symposium, correlated program by the Society of Aircraft Materials and Process Engineers and the Magnesium Assn., Institute of Aeronautical Sciences Bldg., Los Angeles, Calif.

June 5-6—13th Annual National Meeting, Armed Forces Chemical Assn., Hotel Traymore, Atlantic City, N. J.

June 9-12—American Rocket Society Semi-Annual Meeting and Astronautical Exposition, Hotel Statler, Los Angeles, Calif.

(Continued on page 6)

AVIATION WEEK Including Space Technology

April 28, 1958
Vol. 68, No. 17

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TELEMETERING COMPONENTS for Severe Environment

IRE SHOW
Booth Nos.
3038 & 3039

HIGH POWER RF SWITCH, TYPE 1696 will switch a transmitter from one antenna to another at high power levels without mismatching the transmitter for *safe switching under power.* This unit is also applicable for ground use. FREQUENCY RANGE: 215 to 250 Mc/s (other ranges on special order); ATTENUATION: 0.25 db, maximum; POWER RATING: 100 watts R.F. C.W.; VSWR: 1.2 maximum; SWITCHING TIME: .15 sec. average; SIZE: approximately 2½ inch diameter by 4½ inch long; WEIGHT: 2 lbs.; ACTUATING POWER: 6 watts D.C.; CROSS TALK: 27 db down into unused channel; SEQUENCE: Make-before-break.

ANTENNAS, tailored to specific missile requirements.

ENVIRONMENTAL SPECIFICATIONS FOR HIGH POWER RF SWITCH, ANTENNAS, DIPLEXER AND VSWR MONITOR

- **SHOCK:** up to 100 G
- **VIBRATION:** up to 20 G at frequency of 2000 cps.
- **TEMPERATURE:** Type 1696: −40°F to +250°F.
  - Antennas and Type 1231: Up to 350°F. (Type 1231 made of Invar may be provided at extra cost for use up to 500°F.)
  - Type 1273: Calibration shift of less than 3% between 70°F. and 310°F. Satisfactory operation as low as −40°F.
- **ALTITUDE:** Unlimited. All units are hermetically sealed.

DIPLEXER CAVITY, TYPE 1231

Two Diplexer Cavities and circuitry comprise DIPLEXER which feeds signals from 2 - 100 watt transmitters into a single missile antenna system. Frequency Ranges: 215 to 250 Mc/s, other ranges on request; Frequency Spacing: 3 Mc min.; Size and Wt.; each cavity approx. 3" diam. x 4" long. TRIPLEXER with characteristics similar to Type 1231 can be supplied.

VSWR MONITOR, TYPE 1273

This unit monitors RF Power, VSWR and Side-Tone amplitude and furnishes 2 d-c voltages representing incident and reflected power so that antenna power measurements may be made. Power Handling Capacity: up to 500 watts output to Indicator: one volt (nominal) from 500 ohms. Frequency Range: 100 to 400 Mc/s. Factory calibrated at desired frequency.

HYCON EASTERN, INC.

75 Cambridge Parkway Dept. W Cambridge 42, Massachusetts

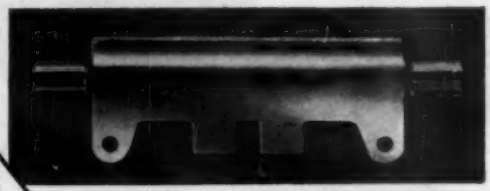
HERE IS THE REMARKABLE

ROTARY ACTUATOR

DESIGNED BY CLEMCO

AERO PRODUCTS, INC.

opening up new horizons in the field of aircraft and guided missiles for the world today... for the universe tomorrow



NOW, CLEMCO ANNOUNCES NEW FEATURES WHICH COMPLETELY REVOLUTIONIZE ROTARY ACTUATOR PERFORMANCE!

New CLEMCO developments in seals have now, for the first time, overcome the leakage, friction, and lost motion barriers.

For the first time CLEMCO has developed stress and deflection analyses which result in rotary actuators of minimum weight, with complete assurance of structural integrity.

NOW, THE THEORETICAL ADVANTAGES OF ROTARY ACTUATORS BECOME A REALITY!

Here's the proof! Internal leakage of less than .05 G.P.M. at 3,000 P.S.I. with static friction of less than 12 inch-pounds is an accomplished fact in actuators having internal seals of a total length exceeding 20 inches. A lower value of internal leakage is practical at the expense of increased static friction.

REMEMBER, CLEMCO HYDRAULIC ACTUATORS ARE CUSTOM DESIGNED

for all modern aircraft and missile applications and can be furnished in an almost unlimited variety of envelope sizes, torque ratings, and dynamic spring constants.

CLEMCO AERO PRODUCTS, INC. are furnishing the leaders of the aircraft and missile industry with the following:

ROTARY ACTUATORS
POWER STEERING UNITS
FLUTTER DAMPERS
MISSILE FINS AND SPARS

PROPRIETARY DESIGNS OF HYDRAULIC AND PNEUMATIC UNITS FOR MILITARY AND COMMERCIAL AIRCRAFT, AND MISSILES

Write for complete Clemco folder to

CLEMCO

AERO PRODUCTS, INC.

210 E. Manville St., Compton, California

AVIATION CALENDAR

(*Continued from page 5*)

June 9-13—Fourth International Automation Exposition and Congress, Coliseum, N. Y., N. Y.

June 16-18—Second National Convention on Military Electronics, Sheraton Park Hotel, Washington, D. C.

June 22-27—61st Annual Meeting, American Society for Testing Materials, Hotel Statler, Boston, Mass.

June 23-July 3—Special Summer Program on Random Vibration, an introduction to the vibration problem in missiles and jet aircraft, Massachusetts Institute of Technology, Cambridge 39, Mass.

June 24-26—31st Meeting, Aviation Distributors and Manufacturers Assn., Mount Washington Hotel, Bretton Woods, N. H.

June 25-27—Air Transportation Conference, American Institute of Electrical Engineers, Hotel Statler, Buffalo, N. Y.

July 4-6—All American Aviation Exposition, County Airport, Pittsburgh, Pa. For details write: All American Aviation Exposition, Executive Headquarters, 210 Semple St., Pittsburgh 13, Pa.

July 4-6—Northeastern States Soaring Championship Contest, Elmira, N. Y.

July 8-11—The Institute of the Aeronautical Sciences, National Summer Meeting, Ambassador Hotel, Los Angeles, Calif.

July 14-15—Triennial Inspection, National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.

July 24-25—Fifth Annual Symposium on Computers and Data Processing, Albany Hotel, Denver, Colo.

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 13-15—Conference on Electronic Standards and Measurements, National Bureau of Standards Boulder Laboratories, Boulder, Colo. Jointly sponsored by NBS, American Institute of Electrical Engineers, and Institute of Radio Engineers.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

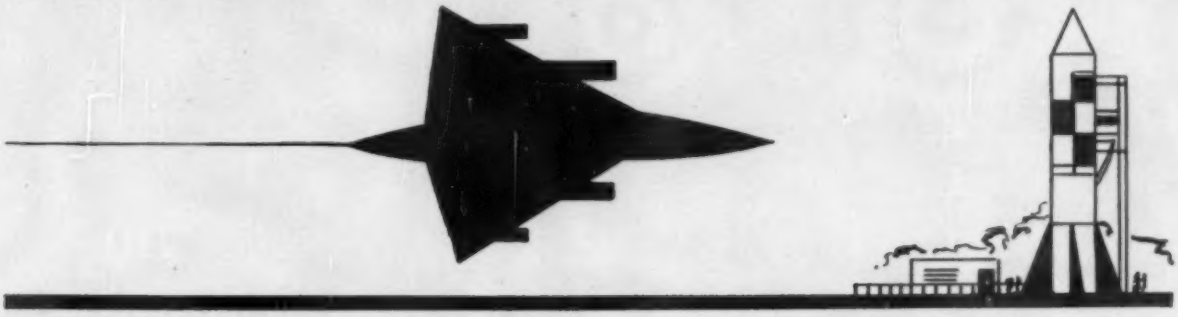
Sept. 6-14—International Aviation Show, Coliseum, New York, N. Y.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

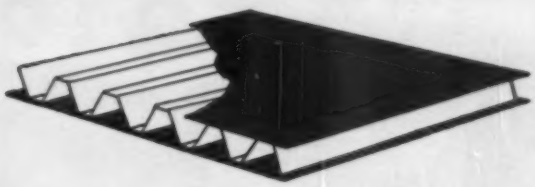
Sept. 8-13—Dynamics of Flight, University of Michigan intensive course for practicing engineers. For details: R. M. Howe, Dept. of Aeronautical Engineering, 1523 East Engineering Bldg., University of Michigan, Ann Arbor, Mich.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

For high strength "Sandwich" structures that MUST withstand heat... specify Armco 17-7 PH or PH 15-7 Mo Stainless

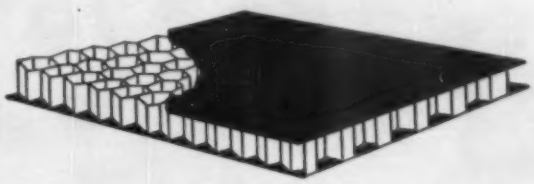


Where structural components of missiles or aircraft are exposed to aerodynamic or engine heat, these special Armco Stainless Steels enable you to utilize the advantages of lightweight construction.



ARMCO PH 15-7 MO AND 17-7 PH:

- **...Are available in thin sheets and in foil down to .001" thick.**
- **...Offer high strength-weight ratios up to 900 F.**
- **...Possess excellent room temperature strength.**
- **...Can be readily drawn, formed, welded and brazed.**
- **...Are heat treated by simple procedures compatible with brazing and welding schedules.**



WIDELY USED

Designers are using 17-7 PH stainless for thin gage fuselage panels, nacelle skins, ailerons and similar units for our newest missiles and aircraft. And PH 15-7 Mo, a new material with even greater strength and resistance to heat, is being specified for similar structures now on the drawing boards. Consider the many advantages of these special Armco Stainless Steels—not only for sandwich structures, but wherever you require a combination of high temperature strength, corrosion resistance and good fabricating characteristics. For complete information on the properties and fabrication of Armco PH 15-7 Mo and 17-7 PH, just fill out and mail the coupon.

ARMCO STEEL CORPORATION
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Send me design and fabrication data on
- ☐ Armco 17-7 PH Stainless
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An R&D leader in the field of ground and airborne IFF components, test & checkout equipments—IFF systems analysis—Air Traffic control systems—radar beacontry—detection equipments.

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Leaders in electrically driven and spring-wound free gyros, rate and floated rate gyros for missile systems—rate of roll, pitch, and yaw indicators for manned aircraft—bank and turn indicators.

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Pioneers in equipments for fast and accurate analysis of test data, with automatic recording on punched cards, tapes, or printed lists—for aircraft, missile, industrial and scientific uses.

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Currently engaged in reduction and analysis of flight test data generated by daily missile firings at Holloman Air Force Base, White Sands Proving Grounds Integrated Range.

WHITTAKER CONTROLS
The largest developer and builder of custom-built high-performance hydraulic, pneumatic, and fuel valves, controls, and regulators for advanced missile, aircraft, and industrial applications.

NUCLEAR INSTRUMENTS
Designers and builders of high quality, reliable equipments for prelaunch checkout and testing of nuclear special weapons.

no valve or control problem too complex for Whittaker engineers

TELECOMPUTING CORPORATION

915 N. Citrus Avenue, Los Angeles 38, California

PERFORMANCE REQUIREMENTS

For a pressure actuated valve, controlling flow of helium for LOX tank pressure regulation:

Ambient Temperature
−65° F to +120° F

Temperature Shock
−260° F for 5 seconds, then to +400° F in 25 seconds

Pressure Shock
0 to 3000 psi in ½ second

Control Tolerance
26 psig, +zero, −1.3 psi, in small ullage

Response Time
Zero to rated flow in ½ second.

Design considerations:
Rate of flow of helium is fixed by rate of evacuation of LOX tank;
friction in all metering elements must be minimal at all temperatures;
chatter must be prevented despite pressure shock;
response must be rapid despite long signal sensing lines.

Results: A valve (P/N 121485) meeting all of these requirements is now operational — another Whittaker contribution to America's missile program.

WHITTAKER CONTROLS OFFERS THE INDUSTRY'S TOP FACILITIES FOR:

Research and Development

Prototype Production

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Field Servicing

These facilities, together with the industry's most resourceful and competent engineering and technical personnel, are at your disposal, to solve your most exacting hydraulic, pneumatic, and fuel valve and control problems.

Put them to work today. Write, wire or phone:

Arthur C. Cocagne, Director of Field Engineering, Whittaker Controls, a Division of Telecomputing Corporation, 915 North Citrus, Los Angeles, California. Phone—HOllywood 4-0181.

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Atlanta, Seattle,
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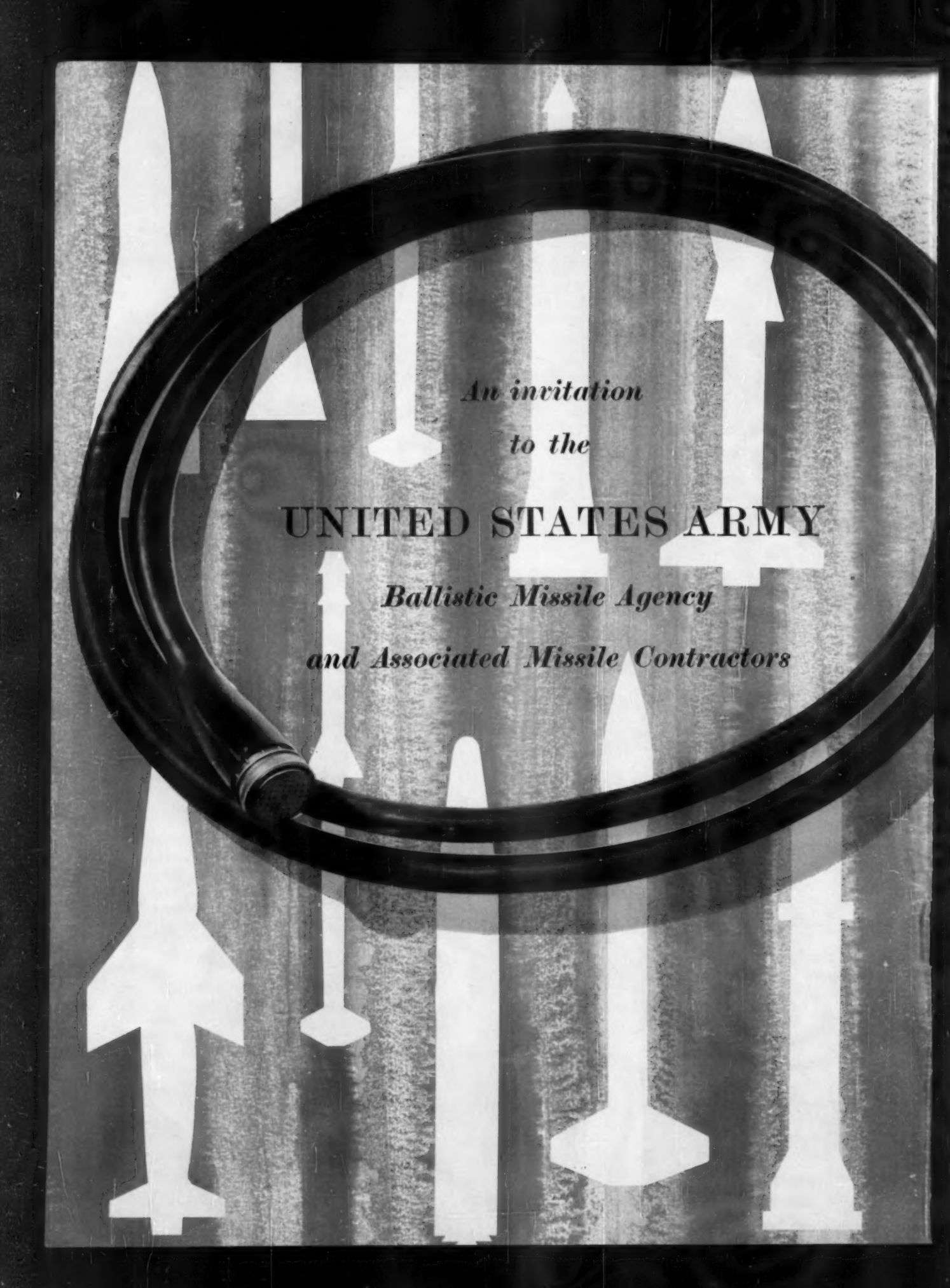

An invitation
to the
UNITED STATES ARMY
Ballistic Missile Agency
and Associated Missile Contractors

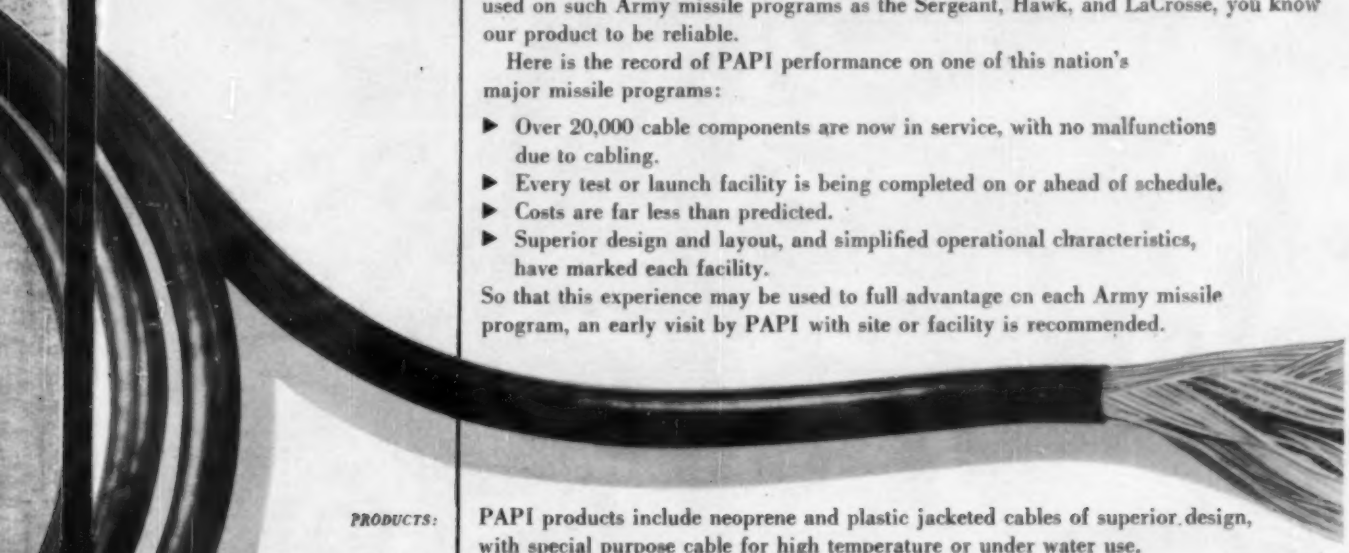
INVITATION: This is an invitation to utilize the missile systems engineering services of Pacific Automation Products, Inc., on current and upcoming Army missile programs.

QUALIFICATIONS: PAPI is an organization of 700 cable systems specialists. Over 150,000 square feet of floor area are now devoted to engineering, manufacturing, inspection, with production capacity to meet any workload. Because PAPI cables have been used on such Army missile programs as the Sergeant, Hawk, and LaCrosse, you know our product to be reliable.

Here is the record of PAPI performance on one of this nation's major missile programs:

- Over 20,000 cable components are now in service, with no malfunctions due to cabling.
- Every test or launch facility is being completed on or ahead of schedule.
- Costs are far less than predicted.
- Superior design and layout, and simplified operational characteristics, have marked each facility.

So that this experience may be used to full advantage on each Army missile program, an early visit by PAPI with site or facility is recommended.



PRODUCTS: PAPI products include neoprene and plastic jacketed cables of superior design, with special purpose cable for high temperature or under water use.

SERVICES: PAPI offers the following services in the cabling and activation of missile test and launch facilities: *Systems Design*—working from schematics, PAPI design engineers will determine every conductor that is needed to link block houses, control centers, terminal rooms, and stands or platforms. Cables are designed to effectively accommodate these conductors, and include break outs, connectors, and accessories. *Systems Fabrication*—cable assemblies leave our plant in ready-to-install condition, with rigorous quality control procedures governing every step of the fabrication process. *Systems Installation*—PAPI's experienced personnel and proven methods are utilized in field installation of all inter-unit cabling, instrumentation, recorders, transducers, controls, consoles, and accessories. *Systems Checkout*—PAPI specialists checkout all circuits for conformity to specifications, confirm the operation of each instrumentation system, and validate the fire and launch control functions. *Systems Documentation*—working drawings of the entire installation are supplied in approved form.

CONCLUSION: PAPI's engineering staff includes men with outstanding experience in every pertinent phase of the missile business. It is no accident, therefore, that we are the "take charge" sort of people who can take full responsibility for providing the services described in this message. We hope that you will accept this invitation and plan to utilize PAPI's great practical knowledge and experience in Army missile facility cabling and activation.

Arthur P. Jacob

ARTHUR P. JACOB, EXECUTIVE VICE PRESIDENT

PACIFIC AUTOMATION PRODUCTS, INC.

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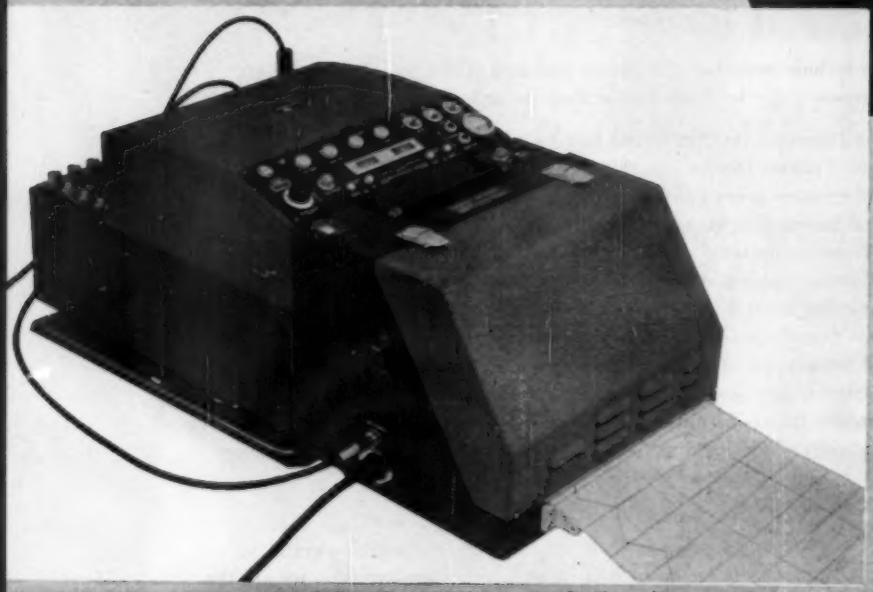
ENGINEERS—NEW PRODUCTS MEAN NEW OPPORTUNITIES AT PAPI. SPECIAL NEED FOR MISSILE OR AUTOMATION SYSTEMS EXPERIENCE. SEND YOUR RESUME TODAY.

This is what we mean by *rapid-access* DATARITE

This instrument places visible, developed, dry and ready-to-use oscillograph records in your hands within 0.8 seconds after exposure.



DATARITE and 5-119 Recording Oscillograph

...*only DATARITE can offer*...visible records at the instant the paper emerges from the magazine exit...no further processing...unmatched trace contrast and clarity...a *true* rapid-access magazine which uses standard commercially available thin-base recording papers ...400-ft. record capacity...internal flash processing with a single chemical solution...no toxic chemical sprays or vapors...standard light source...oscillograms which can be easily duplicated by any conventional process...permanent test results continuously *while* the test is in progress.

DATARITE Magazines directly replace the standard magazines of both the 5-119 and 5-114 Recording Oscillographs without special attachments or modifications.

These combinations provide a unique, transportable recording instrumentation package for on-the-spot analysis of complex military and industrial systems. For complete information on DATARITE—on how to eliminate testing-bottlenecks—contact your nearest CEC field office, or write for Bulletin CEC 1598-X16.

Consolidated
Electrodynamics

300 No. Sierra Madre Villa, Pasadena, California

OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

to make the moon the free world's high ground

The skills and talents of the Westinghouse Electronics Division have been directed to research and development in these critical fields to help find the answers to man's next major space accomplishment . . . reaching the moon . . . and beyond.

These activities are typical of the Westinghouse projects for present and future military applications. They are facets of the Electronics Division's abilities and capabilities to design, develop and produce systems and sub-systems for the conquest of space.

Westinghouse Electronics Division, P.O. Box 746, Baltimore 3, Md.

J-02304

WESTINGHOUSE ELECTRONICS DIVISION

MILITARY SYSTEMS

RADAR
COMMUNICATIONS
MISSILE CONTROL
DATA PROCESSING AND DISPLAY

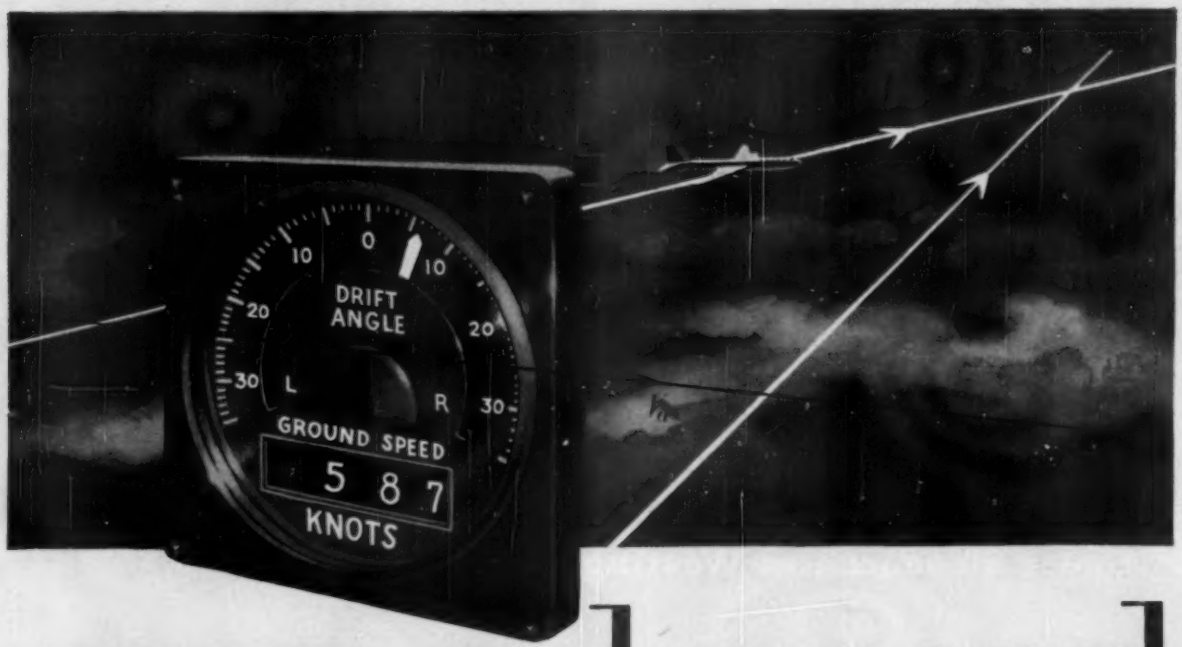
YOU CAN BE SURE...IF IT'S Westinghouse

One of GPL's ground speed and drift angle measuring equipments, AN/APN-81, provides basic input information to computers which tell Air Force WB-50s exactly where they are every flight second.

GPL auto-navigators give an instantaneous and continuous display: Ground Speed and Drift Angle; Wind Speed and Direction; Longitude and Latitude; Shortest Course-To-Destination; Steering Signal To Pilot (or autopilot).

The systems were developed for the Air Force (WADC). They are the result of an achievement comparable in magnitude to the breaking of the sound barrier: GPL's harnessing of the Doppler-effect to air navigation.

The benefits of these GPL systems extend to every area of flight. Their vast potential has just begun to be explored.



ground speed & drift angle

ANY TIME, ANYWHERE, ANY WEATHER

One look and the pilot KNOWS. At a glance, he reads actual ground speed and drift angle, displayed on his flight panel – automatically, accurately, and continuously.

How? Through the famous RADAN* family of self-contained GPL Doppler auto-navigators, recently released for civilian use.

For civilian aircraft, RADAN systems mean pinpoint navigation, reliability, savings in precious time and fuel, a priceless margin of safety. In its wide and growing applications for the military, RADAN provides all these, and continuous velocity data as well.

GPL systems have behind them many millions of operational miles in transcontinental, oceanic and polar flight. RADAN systems herald a new era of faster, safer, more economical civilian flight.

RADAN is ready and available *now* to everyone.

GPL

GENERAL PRECISION LABORATORY INCORPORATED, Pleasantville, N. Y.

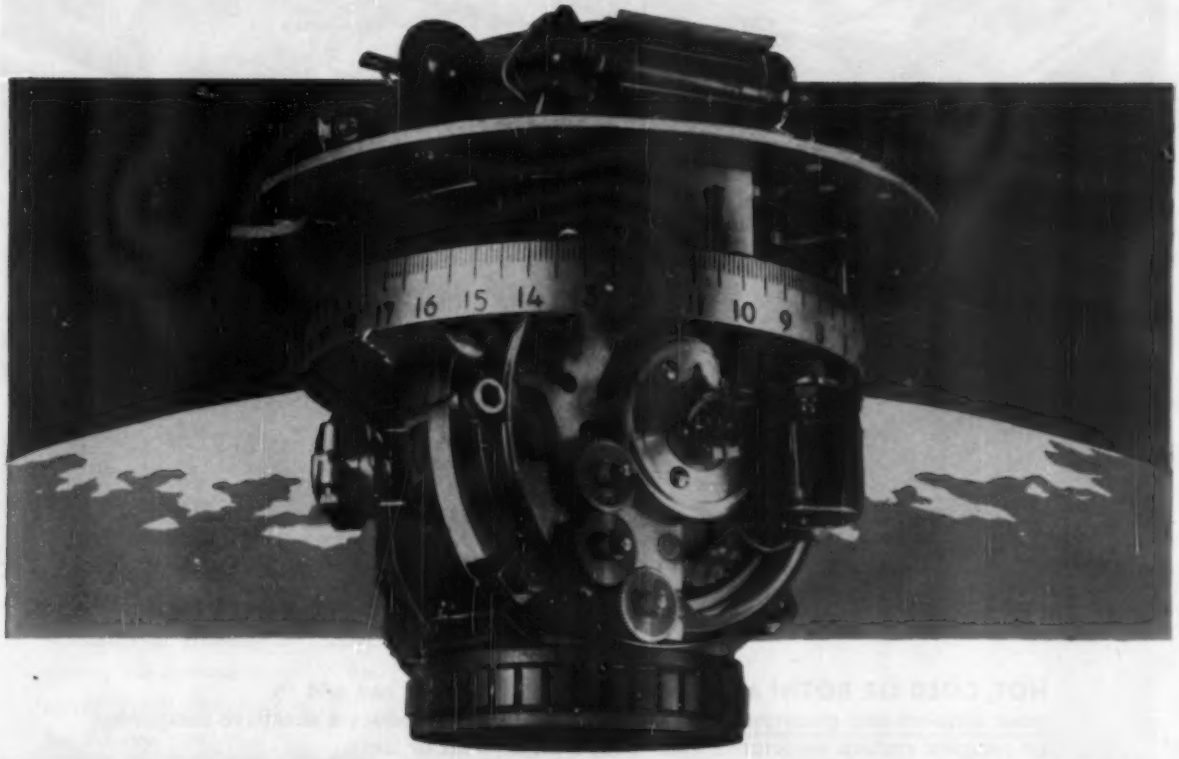
*Trademark

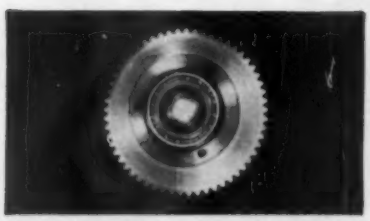
ENGINEERS – GPL achievements have opened up some unusual research and development opportunities. Send resumé to Personnel Manager.

Now...a **non-floated** gyro that cuts random drift 90%

Sperry's Rotorace* Gyroscope technique

uses counter-rotating motor-driven gimbal bearings





CLOSE-UP of Rotorace gear and gimbal bearing. Motor on other side of gyro rotates outer races of opposing gimbal bearings in opposite directions, reversing at predetermined intervals. Action averages out disturbance torques found in even most precise bearings.

The revelation of an entirely new engineering technique, Sperry Rotorace, now makes possible extremely accurate, low-cost gyroscopes. Reduction of random drift rate to only 0.25 degree per hour already has been achieved in systems using these gyros. And in laboratory tests, drift rates as low as 0.05 degree per hour have been achieved.

Rotorace attains this unprecedented accuracy by means of a relatively simple, low-cost method: A small servo motor rotates the outer races of two gyro gimbal bearings in opposite directions . . . then reverses the rotation periodically. Result is that friction is cancelled, errors due to minute irregularities in bearing construction are averaged out, and pitting and wearing of bearings is virtually eliminated.

Rotorace gyros make possible the accuracy of the Sperry C-11 Gyrosyn® Compasses which are now used to guide airliners where ultra-precise navigation is required—especially on transpolar and transoceanic flights. The C-11 with Rotorace gyros will also provide precise navigation for Douglas DC-8 and Boeing 707 jetliners. In addition, Rotorace gyros provide random drift accuracies great enough to enable a guided missile to hit a target 150 miles away with most probable error under 50 yards—an accuracy heretofore unobtainable with non-floated gyroscopes.

If you'd like more information on Sperry Rotorace gyros as applied to the C-11, or, if you have a special application requiring Rotorace accuracy, write our Aeronautical Equipment Division. *T.M.

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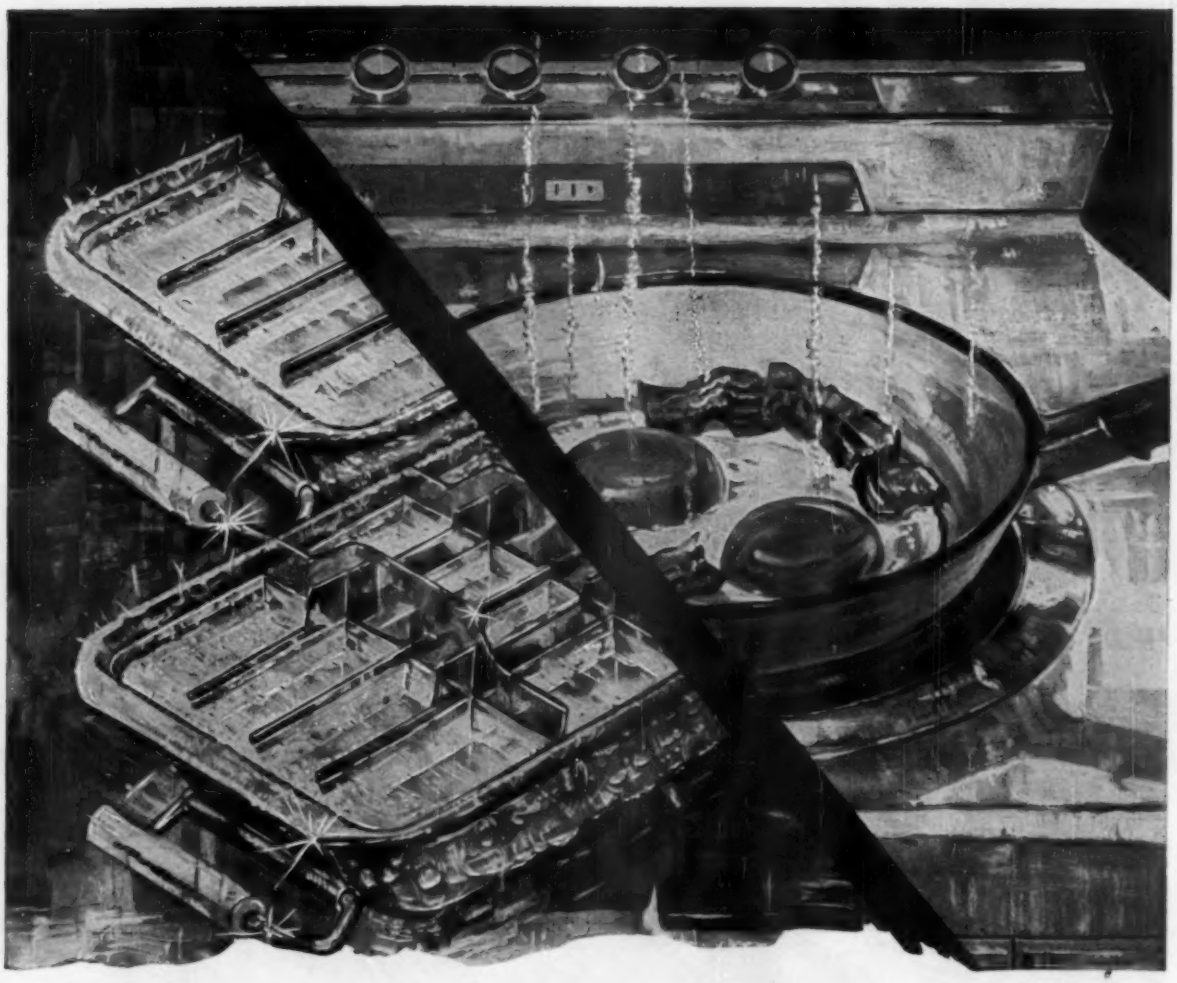

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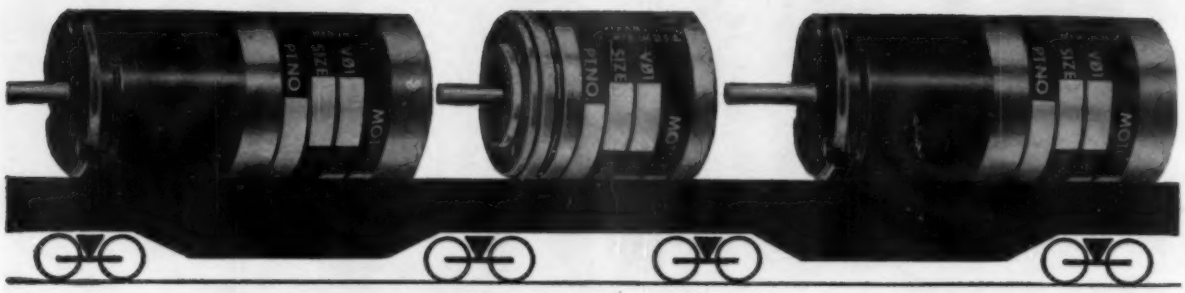

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▶ Proposal to USAF says space station could be put into orbit in five years at cost of $500 million.

Recession Hits Revenue Passenger Miles 38
▶ Aviation Week survey reports first monthly drop in airline revenue passenger miles since 1949.

How Command Guidance Controls Atlas 74
▶ Doppler radar and tracking radar signals feed digital computer; signals transmitted to ICBM correct flight path.

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COVER: First photo of the Atlas Tracking Radar is part of General Electric-Burroughs command guidance system which will direct the United States' first operational intercontinental ballistic missile to its target with accuracy equal to or better than that quoted by Russians for their ICBM. For additional details about Atlas guidance, see p. 74.

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MAGNESIUM ALLOYS BUILD BIGGER PAYLOADS INTO SIKORSKY 'COPTERS

Structural dead weight—that ever critical problem in the design of air frames and missiles—is a problem Sikorsky Aircraft solved several years ago.

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The S-56, Sikorsky's largest 'copter to date, carries a total of 5,558 lbs. of magnesium. This total includes the wheels, almost the entire skin and numerous other components. Several highly stressed areas, such as the rotor hub plates, are magnesium forgings. Other Sikorsky models, such as the S-58 and S-55, famous Korean War 'copter, also use magnesium alloys to good advantage.

For more information about magnesium, contact your nearest Dow Sales Office or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1402K.

MAGNESIUM FORM	LBS. USED		
	S-55	*S-58*	*S-56*
Sheet	580	1303	2288
Extrusions	68	51	246
Castings	307	266	1466
Forgings	77	198	1144
Bar and Tube	83	186	414
Total	1,115	2,004	5,558

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EDITORIAL

Toward Better Traffic Control

Mid-air collision of USAF TF-100 with a United Airlines DC-7 at 21,000 ft. over Nevada last week is another ghastly exclamation point in the sad story of how the speed and numbers of modern aircraft have badly outrun the mechanical and administrative machinery of air traffic control.

Nearly three years ago we sounded the alarm over the acute dangers inherent in the combination of an antiquated air traffic control system and the increases in speed and density of modern air traffic. In a series of editorials in the fall of 1955, we warned that mid-air collisions would be the inevitable consequence of the failure to take drastic and immediate action to dissolve this lethal combination. Since those warnings, there have been five major mid-air collisions involving transport aircraft with a loss of 251 lives, both military personnel and civilians. This is a case in which we would much rather have been wrong in our prophecy.

We thought that the worst danger of mid-air collision would occur in the areas around major traffic terminals. Actually, only two of these major accidents have fallen into that pattern in the Los Angeles area. Two of the worst collisions occurred in the seemingly limitless airspace above the western deserts near the Colorado River at relatively high altitudes.

Congressional Reaction

There is now the usual congressional hue and cry for safety investigations as a result of the collision last week. We are developing a pretty hearty contempt for this type of congressional reaction to acute air safety problems. Aviation Week readers will recall the antics of a special congressional subcommittee that supposedly "investigated" the collision between a TWA Constellation and a United DC-6 over the Grand Canyon two years ago. These gentlemen spent most of their time in Las Vegas casinos and only a few of them even ventured to the scene of the accident.

Congress can make its greatest contribution to increased air safety by voting the funds that are required for modernization of the federal airways system in the shortest possible time, for the development of new avionic devices aimed at improving air safety and for sufficient airports of modern design capable of safely handling the growth of jet transport volume. Too many of the congressional leaders who are the first to take to the House and Senate floors with stirring speeches after each new tragedy are the same people who cut the airways, airports and technical development appropriations of the Civil Aeronautics Administration or who fail to defend the CAA against the slashes inflicted on these vital items by the Bureau of the Budget and the Commerce Department hierarchy.

Fortunately, and thanks to the work of such individuals as the late Chuck Lowen, Ted Curtis, Bill Harding, Jimmy Pyle, Jim Durfee and Pete Quesada, the air traffic control situation is being tackled with great vigor, and machinery is well in motion to achieve a safe and efficient solution to this problem within the next few years.

What's Been Done

Here are some of the things that have been done:

• **Civil Aeronautics Board cut through the Gordian knot** of the Air Coordinating Committee airspace nonsense and exercised its legal right to control airspace for both the military and civil users. CAB has delegated this authority to the Civil Aeronautics Administration whose energetic, active-pilot administrator Jimmy Pyle is working out the details of a unified military-civilian airspace control plan. Unfortunately, this section came too late to prevent last week's collision but offers genuine hope for the near future.

• **Civil Aeronautics Administration is moving** as rapidly as its acquisition of modern search radar will permit toward establishment of a positive traffic control system.

• **Civil Aeronautics Administration has** greatly accelerated its five-year airways modernization program and is moving about as fast as the available money and industrial production lead time will permit.

What congressional critics and executive planners too often fail to appreciate is the inexorable time lag between decisions on action aimed at solving these air safety problems and the time when equipment is developed, procured and installed and men are adequately trained to operate it both on the ground and in the air. All of the vital actions listed above were stalled by years of executive indifference and congressional reluctance to appropriate money for purposes. Such fiascos as the Tacan-DME mess, the political logrolling over a second Washington airport and the Budget Bureau's constant slashing of the airways' modernization budget lie at the root of our lack of air safety progress during the past five years.

More Tragedies Ahead

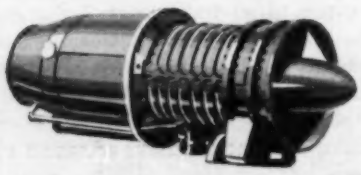
We are bound to suffer some more tragedies under the obsolete system of air traffic control that now prevails. It is the price we are paying for the failure of responsible officials in both legislative and executive branches of the government to act decisively and intelligently in the past. But it would be even more tragic if any furor raised over these current accidents obscured the fact that an intelligent and vigorous drive is now under way to solve these traffic control problems or in any way restricted the speed and the scope of these sound programs now under way.

—Robert Hotz

ACROSS THE U.S. AT 557 mph...

Answering the need for a much faster transport for military and business use, Lockheed's new Jetstar with Curtiss-Wright turbojet engines recently set a new unofficial record by spanning the continent from California to Georgia in 3 hours and 29 minutes. The Jetstar cut more than 1¾ hours from the former transport mark, averaging 557 miles per hour and reaching a top speed of 572 miles per hour. In test flights, the Jetstar has flown over 630 miles per hour.

Curtiss-Wright TJ-37 turbojet engines . . . . product of the cooperative engineering of Curtiss-Wright and Bristol Aero-Engines, Ltd., of Great Britain . . . have a thrust-weight ratio of 4.9 . . . the highest thrust-weight ratio for any current turbojet engine in service today. The TJ-37 is typical of the Curtiss-Wright program that seeks to bring to the United States *better* products *faster*, through reciprocal engineering agreements with leading companies in other countries of the Free World.



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WHO'S WHERE

In the Front Office

J. E. Jonsson, board chairman, Texas Instruments, Inc., Dallas, Tex. **Patrick E. Haggerty** succeeds Mr. Jonsson as president.

Saul S. Schiffman, board chairman, Tenney Engineering, Inc., Union, N. J.

Gerald J. Horvitz, president, and **Robert Slegman**, vice-president, New York Testing Laboratories, Inc., New York, N. Y. Also: **Gerald Harvey**, secretary and technical director, and **Roger Harvey**, treasurer and managing director.

J. H. Overholser, president, and **Robert T. Skinner**, executive vice-president newly organized Hydrodyne Corp., North Hollywood, Calif. Mr. Overholser is a co-founder of Hydro-Aire, and Mr. Skinner is owner of Skinner Seal Co.

Capt. John H. Halliburton, vice-president-flight operations, Eastern Air Lines, Inc. Also: **Harrison K. Knapp**, assistant vice-president-federal and state regulatory matters, and **Charles A. Glover**, assistant vice-president-interline sales.

L. C. Schaefer, vice-president-engineering, Torq Engineered Products, Inc., Bedford, Ohio.

Republic Aviation Corp., Farmingdale, N. Y., has retained the following scientists as consultants: **Dr. Antonio Ferri** of Brooklyn Polytechnic Institute; **Dr. Charles S. Draper** of Massachusetts Institute of Technology; **Dr. Winston Bostick** of Stevens Institute of Technology; **Dr. John L. Barnes** of the University of California.

Honors and Elections

Harper Woodward, associate of Laurance S. Rockefeller, has been elected chairman of the Board of Governors of Flight Safety Foundation Inc., New York, N. Y. **Frederick F. Robinson**, president of National Aviation Corp., was named vice-chairman.

Frank W. Hulse, board chairman of Southern Airways School, has been elected president of the Aeronautical Training Society, Washington, D. C. **Clarence E. Page**, president of Page Aircraft Industries, was elected vice-president.

James H. Kindelberger, board chairman of North American Aviation, Inc., has received the National Managament Assn.'s Gold Knight Award, which is presented annually to the man deemed by the NMA to best exemplify leadership in good industrial management.

Changes

William A. Stevenson, assistant division manager for missile design (Polaris), Lockheed Missile Systems Division, Sunnyvale, Calif.

G. H. Ward, B-58 engine program director, Aviation and Defense Industries Sales Department, General Electric Co., Fort Worth, Tex.

Delvin E. Kendall, chief-systems research and development, and **Robert C. Mack**, chief-systems development, Kaman Aircraft Corp., Bloomfield, Conn.

(*Continued on p. 101*)

INDUSTRY OBSERVER

► Manned lunar probe vehicle using ion propulsion and capable of carrying a 2,200 lb. payload around the backside of the moon and returning it to earth in about three months has been proposed to Defense Department by General Electric Co. Vehicle would employ small nuclear powerplant to provide electric power required for propulsion.

► **Air Force is requesting industry proposals for navigation systems suitable for guiding military space vehicles on interplanetary missions, with no holds barred insofar as the techniques employed. Program is under cognizance of Wright Air Development Center's Weapons Guidance Laboratory.**

► Navy's human centrifuge at Johnsville, Pa., will be used for extensive studies of effects of buffeting and oscillation in the transverse-G field, probably beginning this summer. Similar studies, necessary for designing systems for escape during takeoff and re-entry of space vehicles, have been done by Aero Medical Laboratory at Wright Air Development Center, but larger Johnsville centrifuge allows studies of buffeting with a device that rocks man back and forth while he undergoes G forces.

► **Air Force aeromedical experts believe existing protective clothing and liquid oxygen system would be sufficient to sustain man in a two-hour orbital flight, which would allow two trips around the earth. Suit would be the MC-2 full-pressure suit developed by Wright Air Development Center and David Clark Co. For longer flights, sealed cabin probably will be necessary and full-pressure suit would be used only for emergencies.**

► Rocketdyne Division of North American Aviation is well along in the development test of a new thrust chamber which had an original specification of 300,000 lb. thrust. Chamber is now being included in applications designs on the basis of 450,000 lb. to 500,000 lb. thrust. Chamber is like other Rocketdyne units. It can be used in cluster for large thrust engines and has a development stretch for higher thrusts with fuels available.

► **Grumman F11F-1F Super Tiger will be manufactured in Japan under license by the Mitsubishi Heavy Industries combine and the Kawasaki Aircraft Manufacturing Co. General Electric's J79-7 turbojet with afterburner to power the Japanese-built Super-Tigers will be manufactured under license by the Ishikawajima Heavy Industries aircraft division in Tokyo. Japanese mission will visit the U. S. this summer to reach detailed agreements on licensing, Japanese production schedules and amount of U. S. government financing that will support the Japanese purchase of 300 Super-Tigers. Japan hopes the U. S. will pay about 45% of the total Super-Tiger program cost.**

► Texas Instruments is developing an infrared tail warning system which also could have fire control and missile guidance applications.

► **National Advisory Committee for Aeronautics is conducting flight quality tests at Edwards AFB, Calif., with a Boeing KC-135 jet tanker under loan from Strategic Air Command. Stratotanker is being used as a testbed to determine flying and landing approach characteristics of high-speed jet transports. Data will be made available to the CAA and airline industry.**

► First flight of Kaman Aircraft Corp.'s K-17 commercial helicopter was made last week from the firm's Bloomfield, Conn., plant. Pressure-jet prototype flew with Army markings. Army financed a portion of the development program. The remainder of the project was company sponsored (AW April 14, p. 73). Two-man helicopter is designed for low cost operations and is powered by a Turbomeca Turmo 600 turbine engine.

► **Southwest Research Institute has developed a recording accelerometer that could be used in checking shocks occurring during the transportation of missile systems. Device could provide a record that would show whether a missile had suffered a jolt heavy enough to damage instrumentation. Recording accelerometer was originally developed to study ground impact shock involved in aerial delivery of equipment.**

Barden Precision SR1-4 miniature bearings as used in a linear or non-linear potentiometer.

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Washington Roundup

Moon Timetable

U.S. could land a man on the moon within eight years after receiving a go-ahead, Brig. Gen. H. A. Boushey, USAF deputy director of research and development, told the House Committee on Astronautics and Space Exploration last week. Gen. Boushey said establishment of a moon base would have both civilian and military advantages—as a supply base for flights to other planets and as a secure base to deter aggression.

Maj. Gen. John B. Medaris chief of the Army Ordnance Missile Command, said the Army's unmanned lunar probe project recently approved by the Advanced Research Projects Agency will be completed by next April. Army also will have completed its present satellite program by that time, Medaris said.

Surveillance Techniques

Obscure reference to potentially significant new world-wide surveillance technique now under investigation and the possibility of using the moon as a reconnaissance satellite without landing men or equipment came out during testimony of Navy's research and development chief before House Committee on Astronautics and Space Exploration.

Rear Adm. John T. Hayward answered "Yes" to two questions posed by Rep. James G. Fulton (R.-Pa.): "Do we have it in our power soon to monitor the whole world . . . through electronic process of ion emission?" and "Do we have capability through electronic means to use moon as a reconnaissance satellite . . . ?"

Top Navy spokesman later indicated that the Congressman had knowledge of "highly classified" investigations now under way but that technical language used in his questions could be "misleading."

The world-wide monitoring technique may be same one under investigation by Stavid Engineering Co. (AW Jan. 6, p. 23.)

Southern Transcontinental

Southern Transcontinental Route Case, which has been pending before the Civil Aeronautics Board for almost nine years, last week drew applications from seven trunkline carriers and one local service airline. In its call for a prehearing conference which will be held May 5, the Board indicated the route would serve nine cities between Miami and Los Angeles-San Francisco. Carriers involved in the case are American, Continental, Delta, Eastern, National, TWA and Western. Pacific Air Lines petitioned to intervene and consolidate certain of its application since, the airline claimed, any service authorized between Las Vegas, Nevada and West Coast points would be the same service sought by Pacific.

Single Transport Agency

A single federal agency to regulate all land, sea and air transportation in the U.S. is recommended in the most recent report of the Rockefeller Brothers Fund Inc. Administration is now split between three agencies —the Interstate Commerce Commission, the Civil Aeronautics Board and the Maritime Commission.

The Rockefeller report calls for an "immediate study to assemble more comprehensive and reliable data as to the productivity of various types of transportation with particular reference to the costs and advantages of each." The report adds that no genuinely coherent system of regulation providing sound growth for all phases of the transportation industry and lower rates for the customer is believed possible under the present arrangement.

Most pointed reference the report makes to the troubles of the scheduled airlines is that financing of new jet equipment is threatened by the "inability to make adequate rate increases . . ."

Crewmember Battle

Key to the controversial third crewmember battle now being waged by Air Line Pilots Assn. and the Flight Engineers' International Assn. will lie in the decisions reached by the Presidential Fact Finding Board which resumed hearings last week in Washington. The board convened on Feb. 10 in New York to hear the dispute between the engineers' union and Eastern Air Lines. The same board, under a separate case number and file, heard the dispute between the pilots' union and Eastern beginning March 11 and then recessed just before Easter The present discussions between the two unions and Eastern are viewed by the industry as an important test case.

Airlines are hopeful the outcome will resolve a controversy which already threatens to delay inauguration of turbine powered scheduled service. However, most observers feel that neither union will budge to any great degree from the firm position each has taken in the struggle.

Britannia Purchase

Possibility that Northeast Airlines will offer Bristol Britannia turboprop service on its New York-Florida route this fall again appears strong. Terms between the airline and the manufacturer provided that Bristol had until May 1, 1958, to obtain an American certificate for the aircraft or else the contract would be terminated. The agreement also stated that, if certification was granted, Northeast was to be allowed 60 days in which to arrange necessary financing for the five Britannias. Earlier this month, the Britannia was certificated in Paris by the Civil Aeronautics Administration (AW April 21, p. 24), and Northeast is now negotiating for bank loans to finance the purchase.

Traffic Jam

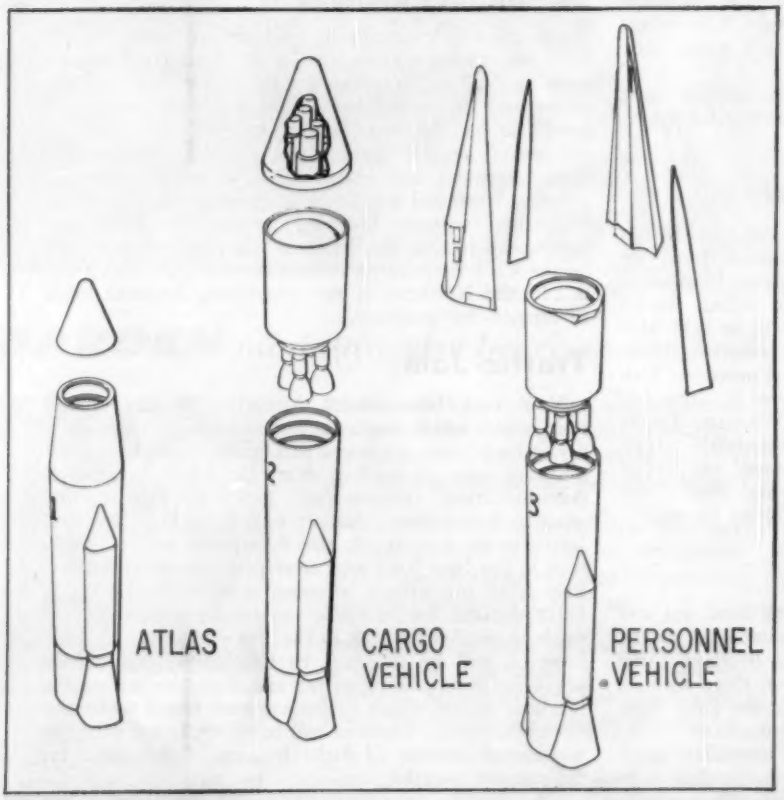
New York International Airport's "North Atlantic rush hour," which begins at approximately 4 p.m. each day and continues at a hectic pace until 6 p.m., has drawn a strong word of warning from the Civil Aeronautics Administration. Administrator James C. Pyle recently went to International Airport to talk to U.S. flag and international carriers on the seriousness of the traffic jams in the New York area created by present schedules. Pyle asked the airlines to spread schedules out so that heavy demand for air traffic control services would not reach an intolerable peak in the late afternoon. Airlines, however, will be reluctant to forsake the competitive advantage of scheduling arrivals and departures within the two-hour period which passengers have found to be the most convenient. Problem will be compounded with the widespread increase of flight frequencies scheduled for the summer months.

—Washington staff

KRAFFT EHRICKE, assistant to the technical director of Convair's Astronautics Division, explains space proposal to USAF Lt. Gen. Clarence Irvine. Four-man unit contains (l. to r.) washroom, dining-recreation area, sleep room and control and instrumentation room.

Space Technology

Convair Plans Four-Man Space Station



ATLAS used as space station would be stripped of weapons equipment. Tip of cargo vehicle would carry equipment. Personnel vehicle would carry two two-man gliders at its tip.

By Evert Clark

Washington—Four-man space station that could be put into a 400-mi. orbit in five years at a cost of about $500 million has been proposed to USAF by Convair's Astronautics Division.

Based on the Atlas intercontinental ballistic missile, the Atlas Orbital System provides the means for putting the greatest load into orbit at the earliest time, according to designer Krafft Ehricke, assistant to the division's technical director.

Atlas also has been proposed to USAF as the launching vehicle for a series of Minimum Manned Satellites —aimed at quick solution of the manned re-entry problem—in a joint Avco Manufacturing Corp.-Convair effort.

Re-entry capsule would be an almost spherical, pure-drag body employing a parachute and imposing a peak deceleration load of 9G on the human space traveler.

Both proposals were reported here last week in a speech by Ehricke at the National Press Club and testimony before the House Select Committee on Astronautics and Space Exploration by Ehricke and Dr. Arthur Kantrowitz, director of Avco's research laboratory and author of the manned satellite proposal.

Atlas has successfully completed its

first series of firing tests and can be "principally available for space projects within a year without hampering the Atlas ICBM program," Ehricke said.

Primary structure of the Atlas space station is the modified stainless steel propellant tank of the Atlas itself, and a basic advantage is that the structure can put itself into orbit in one launching.

Seven Atlases

Complete system calls for the use of seven Atlases:

- **Primary structure.**
- **Cargo vehicle containing** parts and heavier equipment for the aft end of the station, including odor absorber, air purifier, etc.
- **Passenger ship carrying** the first four-man crew. Crew would transfer equipment from the cargo vehicle and install emergency power, water and oxygen systems.
- **Cargo vehicle** carrying a four-compartment, rubber nylon crew capsule which would be installed in the front end of the Atlas shell and inflated by pressurized bottle; vehicle also carries food and water and insulation and other installations.
- **Second passenger vehicle,** carrying a relief crew, which would install the capsule, store food and water, check out water and air systems with emergency power.
- **Cargo ship carrying nuclear** auxiliary powerplant, shielding and radiation cooler surface.
- **Ship carrying second relief crew,** which would check-out nuclear equipment, start water and air cycles and fire Atlas vernier engines to provide rotation. Station's rotation every two and one-half min. around an axis through its propellant end will provide .1 to .15G.

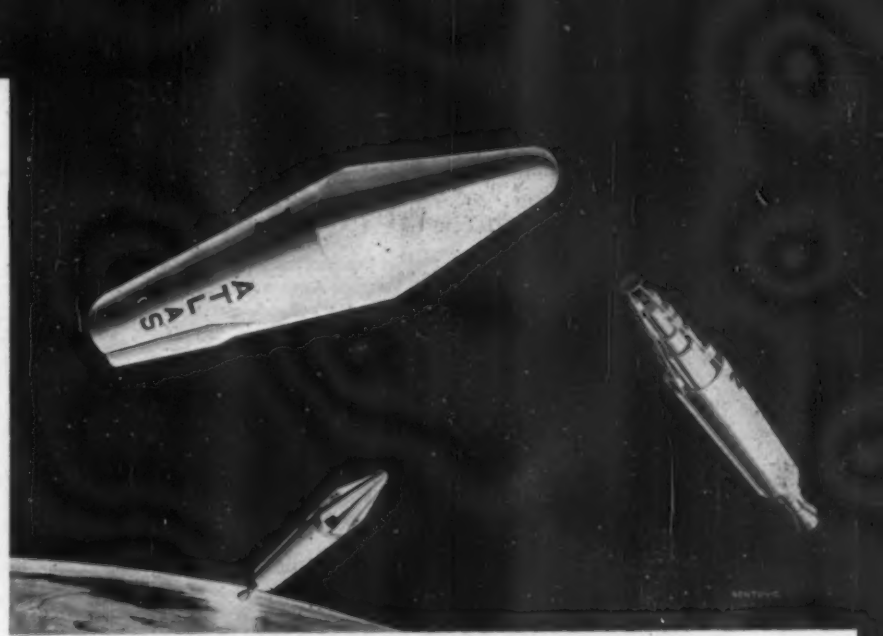
All but the first Atlas might have smaller second stages. With this, an Atlas can put about 8,000 lb. of cargo or a crew of four into orbit.

Station Weight

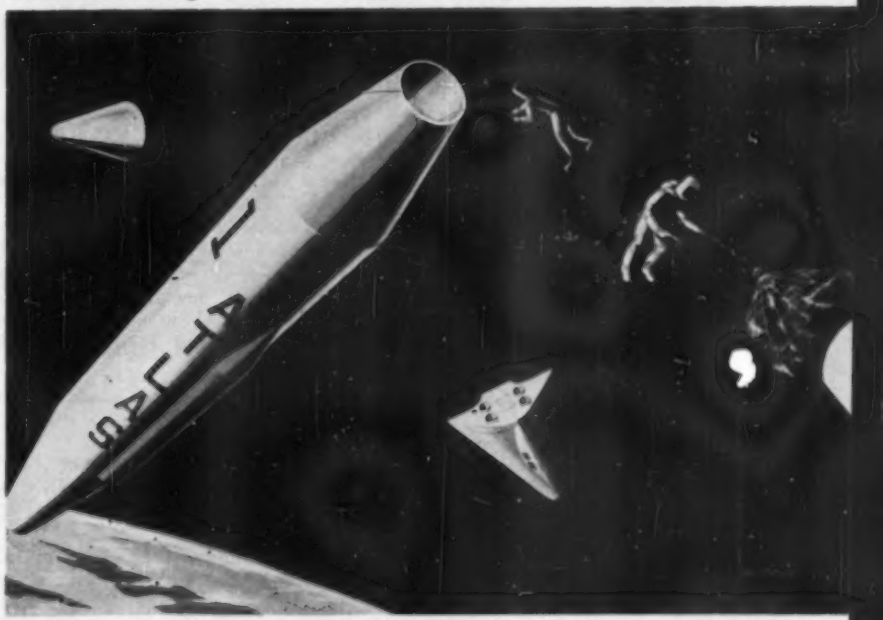
Final weight of the station would be 15,000 lb. and final length probably would be about 106 ft., including the nuclear power supply.

Ehricke said efforts toward improved combustion and slight improvement of specific impulse of Atlas propellants could alter the final length of the missile slightly.

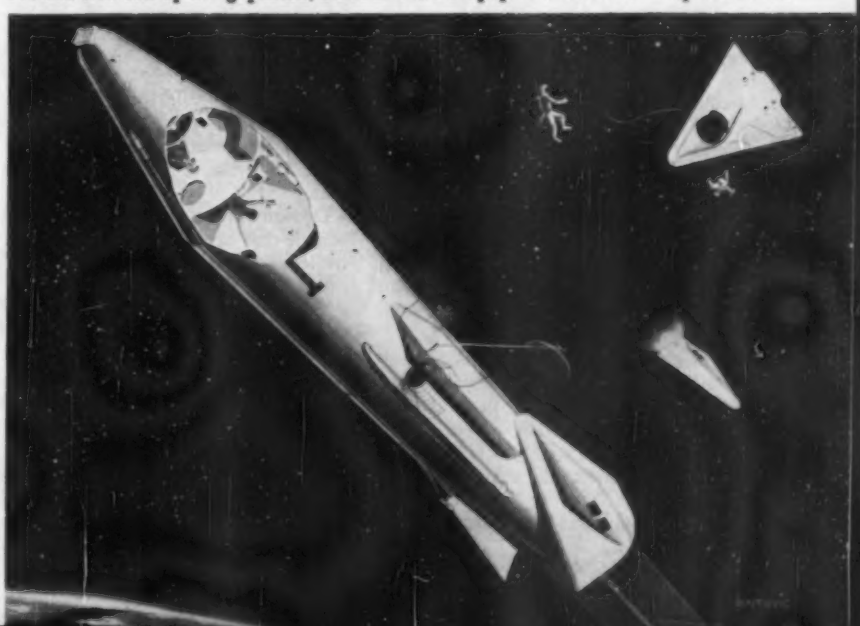
Four basic requirements must be fulfilled before a station can be established, Ehricke said: re-entry capability, countdown precision, reliability of operation and performance of the basic vehicle. He said he believes these last three will have been achieved by Atlas by the time other problems such as re-entry have been solved and the nation is ready to establish a space station.



PERSONNEL and cargo vehicles (above) approach orbiting Atlas space station . . .



. . . and crew sets up living quarters, communications equipment for four-man space station.



Equatorial Lunar Base

Washington—U. S. needs an equatorial base from which to launch lunar and interplanetary vehicles, Krafft Ehricke of Convair's Astronautics Division told the House Select Committee on Astronautics and Space Exploration last week.

Ehricke has suggested that the Christmas Islands in the Pacific are favorably located and could be supplied relatively easily from Hawaii.

Transfer orbits to the moon and planets are more difficult to achieve both from the guidance and propulsion standpoints, the farther the launch site is from the equator, Ehricke said, and waiting times between favorable launch conditions can extend to years and even to decades for particular targets.

Russia's relatively unfavorable geographic location may be one factor in her failure to announce a long-expected shot at the moon, Ehricke said. He added that the Soviet Union might need to launch its lunar prober from Southern China, Indochina or Egypt.

Far northern and southern countries are good sites for tracking observatories for artificial comets at certain times.

"Here we have a clear example of the need for international cooperation in interplanetary experiments, if reason can prevail in these matters over hostile pride," Ehricke said.

He also renewed his call for an International Astrophysical Decade, possibly from 1965 to 1975, and said that "a comprehensive, consistently supported and vigorously executed national space flight program is urgently needed . . . to at least match the Russian rate of progress in this field."

Primary aims of such a space program should be to "stay abreast in space science—that is, not in all specific missions but in the average," and to be "at least as capable as any other nation to operate weapon systems in space with missions pertaining to the earth's surface, and to conduct earth-to-orbit and orbit-to-orbit warfare both in the defensive and the offensive sense of the term," Ehricke said.

He also proposed aiming at "plateaus of accomplishments or levels of capability to bring the confusing variety of possible missions into perspective and avoid diffusing our efforts." Key to each plateau and its group of possible missions is propulsion, he said. He urged "vigorous engineering work" toward a 1.5 million lb. thrust chemical rocket engine and smaller high-energy propellant engines, and more basic and applied research into energy concentration and energy conversion techniques.

Putting man into space now is purely an engineering development program, with no major scientific hurdles left, Ehricke said. Re-entry from the Atlas station would be achieved in two-man gliders.

Avco-Convair re-entry proposal grew out of earlier studies proposed to Air Research and Development Command in November of 1956 but paid for by Avco because ARDC lacked funds. The original Manned Ballistic Rocket System Study indicated that a manned satellite system based on ICBM launchers was feasible. Minimum Manned Satellite proposal followed last November.

Kantrowitz said Avco recognized more than a year ago that the time of the earliest possible launching of a manned satellite would be governed not by the satellite but by availability of a safe, operationally reliable launching vehicle.

"Because of the overriding importance of the reliability factor in any American manned space flight factor, we turned quite naturally to the ICBM which had been tested most, the Convair Atlas," Kantrowitz told the House Committee.

Primary objectives of the manned satellite proposal would be:

- **Establishing in minimum** time a manned orbital flight capability with controlled re-entry to a selected landing location.
- **Determining the problems of** maintaining a man in space with approximately the same capabilities he has on earth.
- **Establishing capability of putting** a man into an "orbit of decision" from which he can land safely or move out into a permanent orbit, using practical space propulsion devices. "Achievement of this objective would be the major breakthrough in establishing manned space flight as a reality," Kantrowitz said.
- **Demonstrating advantages** of a drag vehicle for accomplishing a safe, controlled, manned re-entry from a satellite orbit.

Avco first thought a gradual approach to orbital flight would be most effective, increasing velocities and altitudes of a manned vehicle by steps. Studies indicated, however, that re-entry is most easily accomplished from orbital flight, Kantrowitz said.

Winged and unwinged vehicles with variable lift and variable drag were considered and rejected in favor of a pure drag-re-entry vehicle, he said.

Rapid deceleration would bring a total of 4Gs at peak heating. After peak heating, while the vehicle and parachute were cooling, deceleration would increase to 9Gs. The man would be supported in a nearly-prone position.

After peak deceleration, satellite would slow to a very low speed and the falling phase would take about one-half hour, Kantrowitz said. Impact would be comparable to that of objects dropped by cargo parachutes.

Ehricke's space station could be established in about one week from initial launch, he said. Crews would be rotated regularly, first at two-week intervals, then at four. Cargo ship would deliver fresh supplies and equipment about once a year.

Aircraft Firms List Executive Salaries

Washington—Following is a list of executive salaries and stock holdings filed by aircraft companies with the Securities and Exchange Commission:

LOCKHEED AIRCRAFT CORP.—C. S. Gross, president, $119,488 salary and 12,491 shares of common stock; **C. A. Barker Jr.**, senior vice president, $94,722 salary and 1,030 shares of common stock; **R. E. Gross**, chief executive officer and chairman of the board of directors, $135,928 salary and 72,136 shares of common stock; **C. Chappellet**, senior vice president, $92,488 salary and 9,771 shares of common stock; **D. J. Haughton**, executive vice president, $110,902 and no stock; **H. L. Hibbard**, senior vice president, $91,688 salary and 1,030 shares of common stock; **C. B. Squier**, vice president, $63,502 salary and 2,497 shares of common. **G. Brashears**, director, no salary or stock; **J. V. Carmichael**, director, no salary, 1,030 shares of common stock; **E. S. Dulin**, director, no salary, 250 shares of common stock; **H. L. Dunn**, director, no salary, 250 shares of common stock; **W. W. Keith**, director, no salary, 600 shares of common.

GENERAL DYNAMICS CORP.—J. J. Hopkins, president and chairman of executive board and chairman of the board of directors (deceased 5/3/57), $56,200 salary and no stock reported; **F. Pace Jr.**, president and director, $129,933 salary and 39,780 shares of common stock; **E. D. Johnson**, vice president and director, $93,117 salary and 5,000 shares of common stock; **J. T. McNarney**, senior vice president, president of Convair Division and director, $101,180 and 2,513 shares of common stock; **J. V. Naish**, senior vice president, vice president of Convair Division and director, $94,095, no stock listed; **J. G. Notman**, senior vice president; president, general manager and director of Canadair Division and director of corporation, $91,950 salary and no stock listed. **R. C. Tait**, senior vice president, president of Stromberg-Carlson Division and director, $80,000, no stock listed.

The following persons had no salary listed: **E. C. Alvord**, director, 2,615 shares of common stock; **W. McC. Blair**, director, 2,800 shares of common stock; **S. C. Coleman**, director, 400 shares of common stock; **W. P. Dixon**, director, 500 shares of common stock; **B. E. Finucane**, director, 1,500 shares of common stock; **J. H. Himes**, director, 3,000 shares of common stock; **I. M. Laddon, director**, 407 shares of common stock.

O. Marx, honorary chairman of board, three shares of common stock; **D. N. McDonnell**, director, 171 shares of common stock; **R. C. Patterson Jr.**, director, 39,780 shares of common stock; **D. Richardson**, director, 100 shares of common stock; **R. F. Windfohr**, director, 6,000 shares of common.

Scientists Urge Strong Civil Space Unit

By Ford Eastman

Washington—Top U. S. scientists and engineers last week urged Congress to create a strong civilian space agency, to lay the groundwork for a sound long-range space program and to forget "spectacular stunts" which have no scientific value.

A majority of the witnesses, testifying before the new House Committee on Astronautics and Space Exploration headed by Rep. John W. McCormack, (D.-Mass.), supported the Administration's proposal to form a civilian space agency with the present National Advisory Committee for Aeronautics as its nucleus. There was, however, opposition to points of the proposal.

Dr. H. Guyford Stever, associate dean of engineering at Massachusetts Institute of Technology and chairman of NACA's Space Technology Committee, called for a space organization capable of giving the U. S. strength over many years and one capable of marked growth.

"I believe that we must not be overly influenced by the desire to do something spectacular on a short-term basis," he said. "We must lay a strong foundation both organizationally and technically.

"In laying the groundwork for our government's major venture in astronautics and space exploration, as this committee is helping to do, the most important consideration is that this activity will be of long duration and of ever growing importance."

Dr. Stever said he would favor sacrificing the prestige to be gained from an early attempt to place man in space for long-term strength. He advocated a step-by-step program with emphasis upon preliminary experimentation.

A similar opinion was expressed by Dr. John Hagen, director of Navy's Vanguard satellite project, who said the U. S. needs a comprehensive master plan for the conquest of space and an organization similar to NACA to carry out the program.

Krafft A. Ehricke, chief of preliminary design and systems analysis at Convair's Astronautics Division, also gave full support to the administration proposal. He said, however, that the director of the new agency should be kept out of politics as much as possible and "given adequate power of decision" as well as the right to make contract commitments exceeding one fiscal year.

Maj. Gen. John B. Medaris, chief of Army's Ordnance Missile Command, expressed serious doubts as to the advisability of placing the control of space in a civilan agency outside the Defense Department. He charged that such an arrangement would greatly increase the need for inter-departmental coordination and make it more difficult to complete projects.

Dr. Simon Ramo, executive vice president of Ramo-Wooldridge Corp., while supporting a civilian space agency, said the major portion of space projects should remain in the Defense Department and that the agency should be confined to the research field.

Ramo added that proposals to send a man into space in a satellite that would orbit once or twice and then return would contribute far more scientifically.

Many of the witnesses, while agreeing with the proposal to transform NACA into the National Aeronautics and Space Agency in general, disagreed with or questioned the language of certain provisions. Major issues are:

- **Whether the agency should have** a 17-man board to meet four times a year as proposed by the administration or a smaller full-time board or commission like that of the Atomic Energy Commission.
- **Whether employes of the agency** should be subject to Civil Service pay scales.
- **Status and authority of** the agency director. Several witnesses expressed the opinion that the agency should be headed by a director with cabinet rank. Others said that the post should be started in a modest way and later grow in status. There was almost complete agreement that the director should be empowered to make quick decisions on specific projects without waiting for a meeting of the board.
- **Whether the military services** should be represented on the Advisory Board as they are at NACA or work with the agency on a liaison basis as the military liaison committee of the Atomic Energy Commission does. Most witnesses seemed to favor military representation on the board but to leave the responsibility to name the service or services represented to the Defense Secretary.
- **Whether the services should be given** a greater role in the space program under direction of the Defense Department and limit the agency's role to research.

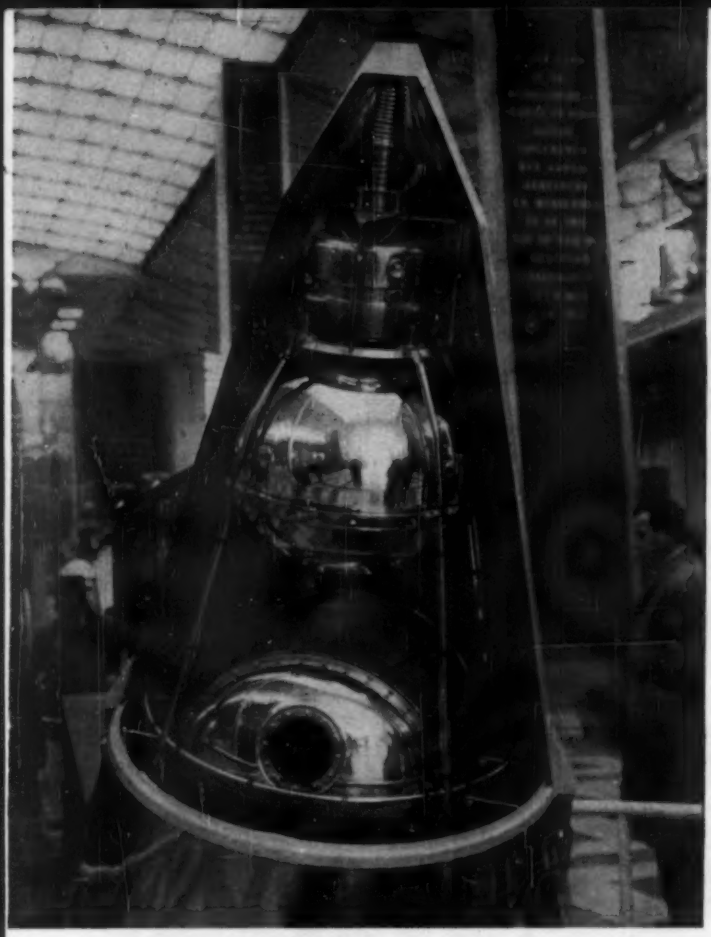
Circus Stunts vs. Science

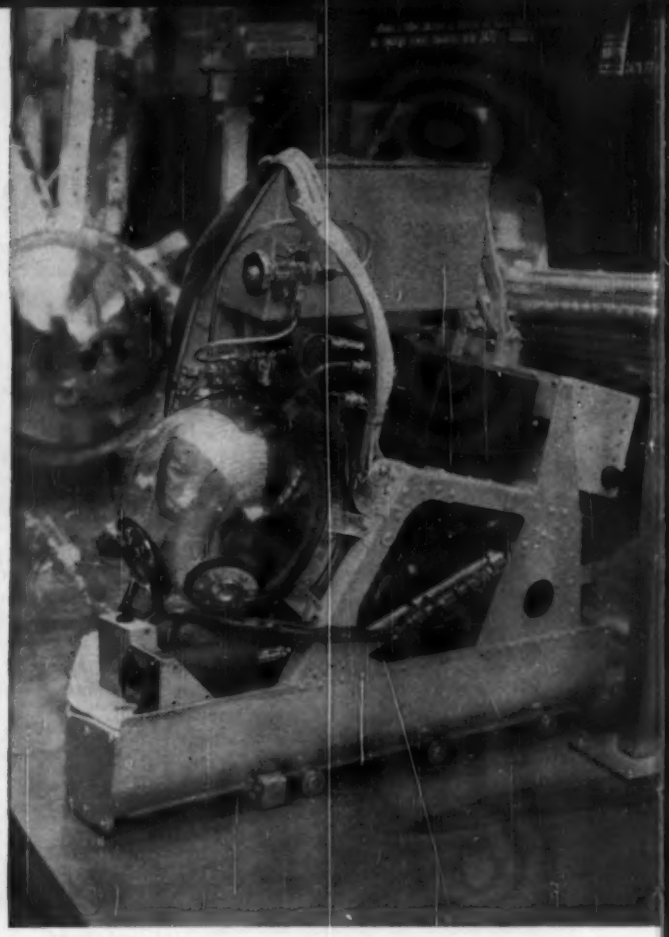
Washington—The difference between spectacular "circus stunts" and space experiments that will yield significant scientific data was explained to the House Select Committee on Astronautics and Space Exploration last week by Dr. Hugh L. Dryden, director of the National Advisory Committee for Aeronautics which has been recommended by President Eisenhower as the nucleus of a new national space agency.

The explanation was stimulated by Wernher von Braun's complaint to the committee that he had been unable to obtain government approval for a proposal to toss a man into space with the Redstone missile and let him fall back to earth. Rep. John McCormack (D.-Mass.), committee chairman and House majority leader, asked Dr. Dryden if he knew why von Braun's proposal had not received government approval. Dr. Dryden replied that he had no specific knowledge on von Braun's proposal but that it was one of about 200 varied proposals now before government agencies for man in space programs. He added that the proposal by von Braun, director of Army Ballistic Missile Agency's Development Operations Division, offered about as much scientific value as "shooting a lady out of a cannon in a circus."

When asked by Rep. McCormack to elaborate, Dr. Dryden explained that the von Braun experiment would add little scientific data at a relatively great cost. The only new data would be an increase in the weightlessness period of a man from the few seconds obtained in T-33 flights to a "few minutes" via the Redstone tossup. Dr. Dryden said the most vitally needed new scientific data in this area was in the re-entry field where an initial speed of 18,000 mph. and a flat angle of re-entry into the atmosphere was required. He indicated that the use of a ballistic missile trajectory to test the re-entry techniques would yield far more useful scientific data than the Redstone "tossup" proposal.

Dr. Dryden indicated that the big problem of any space agency would be to sift the myriad program proposals received from industry and military services to utilize available funds for those that would produce maximum scientific information rather than spectacular "circus stunts."





SPUTNIK II model (left) shows double-walled nose cone. Recoverable dog capsule (right) was used for preliminary study by Russians.

Russians Emphasize Space at Brussels

METEOROLOGICAL rocket nose probe has four thermal manometers (top); resistance thermometers (center) and bolometer (slotted section).

By David A. Anderton

Brussels—Russian progress in space technology is main point of extensive Soviet exhibits at the Brussels world's fair.

Full-sized mockups of Sputniks I and II and a large collection of associated rocket equipment, placed in the center of the main hall of the USSR building, outdrew other aspects of Soviet culture. Cutting through the general noise level could be heard the recorded, continually broadcast "beep . . . beep . . . beep" of Sputnik I.

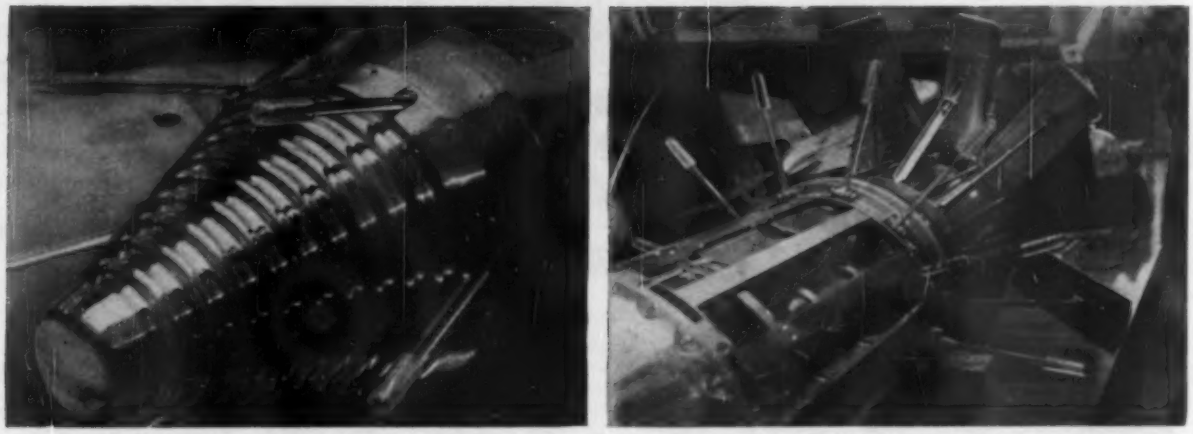
Exhibition models of the latest Russian jet and turboprop transports now entering service with Aeroflot surround a gigantic statue of Lenin in the place of honor at the rear of the hall. Below them are large cutaway models of the fuselages with complete interiors detailed down to tiny lamps and stewardesses. Even the crates in the baggage compartments are stencilled authentically; the labels all read "caviar."

In contrast, American firms exhibiting aeronautical material at the fair are located at one end of the grounds, far from the U. S. pavilion. One section of the U. S. building has an excellent exhibit of the International Geophysical Year program and contributions made by U. S. science.

Full-size mockup of Sputnik II dominates the space exhibit. No information was available on its launching rocket. Only new aspect is the double-walled nose cone that surrounded the satellite proper. One nice detail: a large coil spring at the tip of the nose cone is used to separate it from the instrumentation package.

A huge recoverable instrument container, used in upper-atmosphere studies, shows an unusual multi-stage braking system, consisting of two parachutes and petal air brakes. Similar containers have been recovered after shoots to altitudes on order of 125 mi.

On the downward leg of the trajectory, the container streams a parachute and opens its petal brakes which gradually decelerates the unit. At about 6,500 ft. altitude, the upper dome containing the air brakes and the chute separates from the instrumentation container, deploying a second chute as it does so.



CORRUGATED base (left) of recoverable container is designed for gradual absorption of landing loads. Petal air brakes (right) are used for decelerating instrumentation package. Upper portion spearates from container's main body; both units descend on separate parachutes.

This second chute lowers the instruments, while the first chute eases the cone and brake section to earth.

Container is divided into five basic sections: batteries, for power supply; apparatus for detecting and counting micro-meteorite hits; photographic equipment; manometers and air bottles for sampling the upper atmosphere; parachute and braking system.

Meteorological rocket nose cones, presumably from the "Meteo" rocket described earlier (AW Oct. 28, 1957, p. 67), display unusual nose booms. These extended probes contain four thermal manometers for measuring low pressures, resistance thermometers made of fine wires strung between two spiked collars around the probe, and a bolometer for measuring solar radiation. Below the boom, the nose cone houses batteries, transmitters, cameras and parachute-recovery system. One of the rounds shown had been recovered.

Dog container for rocket research also is displayed; information with it said that dogs flown to altitudes of 65 to 130 mi. showed little change in pulse, respiration or blood pressure.

Above the exhibit is a collection of placards claiming the usual number of Russian firsts in the fields of rocketry and upper-atmosphere studies. Highly retouched photographs show the first Russian rocket launching in 1930, and their first rocket-propelled flight—in a sailplane—on Feb. 28, 1940. According to the same placards, Russian upper-atmosphere studies began in May, 1949, with rocket firings.

American firms exhibiting aviation material at the exposition suffer from their location far out from the center and from the initially incomplete status of the buildings and grounds. As late as the afternoon of the official opening of the Transportation Building, workmen were laying Lockheed's linoleum and building Boeing's stand.

Among the exhibits:

• **Boeing Airplane Co.** shows a mockup section of its 707 jet transport with interior developed for Sabena.

• **Collins Radio Co.** exhibits avionic flight aids.

• **Convair Division** of General Dynamics Corp. and General Electric Co. share space promoting Convair 880 jet transport powered by GE CJ-805 engines. Convair's stand shows a silhouette model of the plane and pictures of exotic places where one might go. Adjacent is a full-size CJ-805 engine.

• **Douglas Aircraft Co.** shows an impressive space-ship cockpit with an integrated flight control and instrumentation system that looks good enough to operate. Stand also features photographs of Douglas transports through the years.

• **Lockheed Aircraft Co.** centers its exhibit on the turbojet-powered Electra. Full-size fuselage section, as done for KLM, Royal Dutch Airlines, is shown in the Netherlands Pavilion, along with a cutaway model of the Allison 501 turboprop engine that powers the Electra.

• **United Aircraft Corp.** shows helicopter models including one of the upcoming Sikorsky S-62s. Perennial original Wasp and Hamilton Standard propeller shared space with the J75 turbojet slated for jet transports.

• **Port of New York Authority** has a model of the main building of the New York International Airport with a multilingual description played through telephone sets in the railing around the model.

Navy Officials Believe F11F-1F Can Top Its New Altitude Record

Edwards AFB, Calif.—Navy and Grumman officials are convinced F11F-1F Super Tiger can top the 76,828 ft. altitude record set here last week by as much as 6,000 ft., given normal weather. Airplane has been over 80,000 ft. several times unofficially using the zoom technique employed in the record flight.

Lt. Cmdr. George C. Watkins, Navy test pilot who made the successful record attempt, reported outside air temperatures 10C warmer than standard at flight altitude. Colder, denser air of a standard day would increase engine output.

Watkins planned an attempt to break his own record early this week but it was uncertain whether National Aeronautic Assn. officials would stay to certify another try. Record must be confirmed by NAA and approved by Federation Aeronautique Internationale to become official.

Powerplant in the record setting airplane is General Electric J79-3A, delivering 15,000 lb. thrust with afterburner and 9,000 lb. thrust without. The airplane was on bailment from the Navy to Grumman.

Record flight lasted about 45 min. Watkins said the zoom to maximum altitude and return to normal altitude required about 80 sec. from the moment the initial climb was established. His problem was complicated by a requirement set at the recent Los Angeles meeting of the FAI, that altitude records be verified by optical trackers as well as sealed barographs. To do this, it was necessary to begin his pull-up in a five-mile square "box" over Edwards so he could be acquired and followed accurately by the Askania trackers. He had to have maximum speed and precisely 400 lb. of fuel left in the airplane.

Flight plan called for an approxi-

mately 230 mi. leg out to Needles, Calif., and a turn back toward the box for the run. Watkins said he played the turn, burning off just enough fuel to begin the run with the right weight aboard. He started back towards Edwards at 39,000 ft. with afterburner on and began a 1,500 fpm. climb aimed at putting him in the box at about 43,000 ft. This is approximately the service ceiling of the airplane with afterburner off. He began his pull-up at Mach 1.9.

For the remainder of the maneuver, primary flight instrument was the G-meter. Pull-up was limited to less than 3G by the necessity of holding a reasonably low angle of attack to keep satisfactory directional stability at high Mach number and altitude.

Before entering the pull-up, Watkins hastily sketched attitude reference lines on the canopy with a grease pencil. Climb angle at the end of the pull-up was about 55 deg. Maximum rate of climb approached 55,000 fpm.

After the initial climb angle was established, the remainder of the maneuver was a near-ballistic trajectory in which, Watkins tried to hold a constant 9.2G load factor upon the airplane. Fractional G flight path minimizes angle of attack and induced drag. Afterburner flamed out due to oxygen starvation at 63,000 ft. and Watkins throttled back to military rated power to keep the engine running. At the top of the trajectory, indicated air speed was 85 kt. The F11F-1F landed with a little over 100 lb. of fuel.

Watkins was awarded the Distinguished Flying Cross for his successful flight which exceeded by 6,520 ft. the record set last August by Michael Randrup of Great Britain in a rocket-assisted English Electric Canberra. Watkins was supported by Grumman test pilot John Norris. This is the first time U. S. has held a world altitude record since 1932. The F11F-1F altitude record project was called Operation Apollo after the late Vice Adm. Apollo Soucek, last U. S. world altitude record holder.

Defense Reorganization Plan Hit by Congressional Group

By Robert H. Cook

Washington—Administration plans to reorganize the Defense Department came under heavy fire last week as Defense Secretary Neil H. McElroy began a defense of the plan before a generally hostile House Armed Forces Services Committee.

Most committee members left little doubt of their mistrust of the Eisenhower proposal which they feel would eliminate much of Congress' authority over military appropriations and its right to assign roles and missions to the military services as spelled out by the National Security Act.

Fear that the Administration bill would amount to a merger of the armed forces into a single unit also was expressed on several occasions, although McElroy discounted the theory.

President Eisenhower said at a later news conference that it would make as much sense to say "Congress is going nuts and will abolish the Defense Department" as to say that he favors a single military service.

The President's remark was challenged during the hearings by Rep. F. Edward Hebert (D.-La.). Hebert said that Eisenhower told him in 1945 that military officers should first receive two years of general training with a single service before joining the Army, Navy or Air Force.

"If that is not merger, I don't know what merger is," he said.

Secretary McElroy said that, whatever Eisenhower's views may have been in the past, the pending legislation rejects the idea of a single service.

Bills counter to the Administration proposal are being sponsored by committee chairman Carl Vinson (D.-Ga.); Rep. Leslie Arends (R.-Ill.), and Rep. Paul Kilday (D.-Tex.).

Major differences between the two plans is that the Administration proposal would concentrate power with the Secretary of Defense by granting him authority to control funds appropriated by Congress, assign roles and missions, assign the Joint Chiefs of Staff as his staff assistants, and organize forces into unified commands answerable directly to the Secretary.

He also would have strategic planning and operational control of the three services, and all responsibility for military operations would be taken from the service secretaries, leaving them with only administrative and training duties.

While President Eisenhower already has ordered the implementation of eight of the major proposals (AW April 14, p. 28), some congressional leaders say they doubt the legality of his action without prior legislation.

In contrast to the "sweeping" changes proposed by President Eisenhower, the Vinson-Arends-Kilday legislation retains most of the present congressional controls over the Defense Department.

It recommends a reduction in the role of the Defense Department in military strategy, planning and control and expands the functions of the Joint Chiefs and the service secretaries. Appropriations would remain under direct congressional control along with responsibility for the assignment of roles and missions to the services.

Indicative of the legislative battle to come was a request by Chairman Vinson that McElroy answer in writing such questions as whether the Eisenhower plan would merge the armed forces, create a single chief of staff or a general staff, why more power is needed over the roles and missions of the services and whether it would be possible to abolish many existing units of the armed forces. The Secretary had earlier denied the merger implication but said he would comply with the request.

One of the major points of contention surrounding the Administration plan is whether it would place military budget funding in the Secretary's hands. McElroy denied that it would and said the legislation only seeks the "flexibility" to transfer needed funds from one service to another in emergencies and for research purposes. He estimated that as little as 5% of the planned $40 billion Fiscal 1960 defense budget would be affected by the authority.

Rep. Overton Brooks (D.-La.) questioned whether the plan could be likened to the German unified high command of World War II or the staff of Gen. Eisenhower.

McElroy, in reply to a question by Rep. Overton Brooks (D.-La.), said that unified commands are desired only in combat forces and that both he and the President oppose a single chief of staff. Instead, he said, they favor a "corporate group," or joint chiefs of staff, which could be expanded.

"A matter of this gravity . . . the involvement of the U. S. in military action . . . should not be left to a single chief of staff no matter how much confidence you have in the man and no matter how strong that man is," McElroy declared.

Under the administration proposal, the President or the Defense Secretary would have direct control over all military units designated as "unified combat commands." Opponents of the bill contend that this literally strips the military chiefs of their powers.

Kilday asked if the military chiefs could lose all their authority by having their forces assigned to military commands. He said:

"You can deprive the chief of staff of the Army of everybody but his aide and orderly."

"Yes, it could," McElroy replied. "It doesn't make sense to me that it should be done, but I think it could."

NAVY FJ-4 Fury fighter makes test run over Naval Air Missile Test Center, Pt. Mugu, Calif., carrying six Martin Bullpup missiles slung under its wings. Below, 600 lb. solid fuel propellant missile configuration shows nose vanes, wing stowage position. At right, men install Bullpup vanes at Navy Weapons Meet.

Bullpup Adds Lethality to Fighter Bomber

El Centro, Calif.—Navy's Martin Bullpup air-to-ground guided missile, formally unveiled at the conclusion of the Naval Air Weapons Meet here, is an extremely simple, visually tracked command guided rocket scheduled for delivery to the fleet in September.

Current model has a conventional warhead and is intended for point-to-point targets such as tanks, trucks and small craft. In at least one instance, a pilot has hit a 4-in. sq. target with Bullpup on his first run with the new weapon.

Navy regards Bullpup as a round of ammunition and it has been designed to require no checkout or testing from the time it is accepted by a fleet air group to the time it is fired. It can be stored aboard ship for long periods without deteriorating.

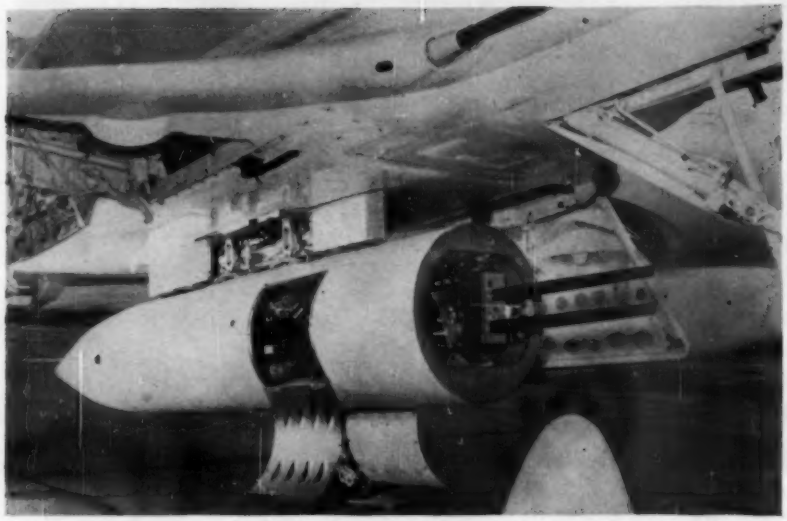
Fins are detached and fuselage is disassembled into three sections for transport or storage. Nose cone section carries radio guidance receiver and is equipped with four canard control surfaces.

The warhead is in center section and solid propellant engine is in aft section. Stabilizing fins on engine section have outboard aft corners permanently bent to impart stabilizing spin to the left. Vertical reference gyro in the guidance section keeps Bullpup control surfaces operating in the proper plane.

Bullpup is 11 ft. long, 1 ft. dia. and weighs 600 lb. The 2 ft. 8 in. long engine section weighs approximately 300 lb. and the 4 ft. 1 in. long warhead weighs about 200 lb. Propellant is manufactured by Allegany Ballistics Laboratory. Warhead is contact fuzed, although a proximity fuze could be used if some application demanded it. Warhead could also be nuclear if a zone-type weapon of this character were needed, but Navy probably would require longer range guidance system than the visual-command equipment now used.

Bullpup is capable of Mach 2 speeds. A North American FJ-4 carries six missiles. Pilot's guidance reference is his gunsight. Control signals are generated by operating control stick with his left hand and are translated into radio commands transmitted to the missile guidance receiver. Visual guidance is obviously line of sight in range and not all-weather.

Bullpup was conceived during the Korean war as an answer to effective



MARK 11 gun pod was shown for first time at Navy meet. Double-barreled 20 mm. automatic cannon is hung beneath fuselage of Douglas A4D Skyhawk.

enemy ground fire and difficult terrain. It was designed to be accurate when launched from beyond the range of guided anti-aircraft and to avoid the necessity of flying into tight canyons. Martin received the go-ahead for full scale development in 1954. First research and development flights were made at Patuxent River, Md. Demonstration and evaluation phases were carried out at Naval Air Missile test center, Pt. Mugu, and are continuing. Rear Adm. Jack P. Monroe, Commander of Pt. Mugu and the Pacific Missile Range, says that Bullpup rounds out Navy's guided missile arsenal and gives it one for every type of target.

Navy also used Weapons Meet here to demonstrate new Mark 11 pod-mounted, double-barreled 20 mm. revolver cannon with a 4,800 round per minute rate of fire. Only General Electric Vulcan has higher rate of fire and recoil-operated Mark 11 has advantage of being completely self-contained without any external power source to drive feed, fire and eject cycle. Single revolver cylinder feeds both barrels. Recoil is converted to rotary motion of revolver cylinder by action of cam track in the last part of the recoil. Gun returns to battery with a loaded chamber behind each barrel. Each part of the firing sequence occurs simultaneously in the two barrels.

Mark 11 was designed by Frank Marquardt of Navy Bureau of Ordnance and is made by Hughes Tool Co., aircraft division.

Gun pod carries ammunition and weighs a total of 1,100 lb. fully armed. Its great advantage is tactical flexibility it offers air group commander. Airplane can be made light for high speed, long range or heavy warhead missions by cutting down on weight of internally carried guns. Pod mounting also might allow pilot to jettison guns for increased range, giving him a better chance of getting home when combat duration or fuel consumption has exceeded planned values. Idea is not new but compact, high-rate gun makes it practical.

During fire power show winding up Air Weapons Meet, Navy demonstrated Sidewinder training technique of launching five-inch rocket from one wing of plane and shooting it down with Sidewinder carried on other wing.

Navy noted that unguided, high speed Zuni five-inch rocket is intended for air-to-air applications as well as air-to-ground.

High altitude dive bombing technique was demonstrated using 70 deg. dive entered at 26,000 ft. with recovery started at 18,000 ft. and completed well above 10,000 ft. Drop was made at 500 kt.

Few observers on the ground saw the airplane.

Medium angle loft bombing with Douglas A3D was publicly demonstrated for the first time. Wingover recovery is used. A nuclear weapon delivery technique demonstrated was parachute-retarded bomb drop with barrel roll recovery to get rid of altitude faster than is possible with straight push-over.

All scores in the week long fleet wide competition have not yet been tabulated, but individual high score in air-to-air gunnery was set by Capt. Charles O. Hiett of Marine Fighter Squadron 232, Kaneohe Bay, Hawaii, flying North American FJ-4. Hiett is reported to have scored phenomenal 96% hits on the last day of competition. High scoring squadron was Alameda-based Navy Fighter Squadron 111.

Boutelle Forecasts Large F-27 Market

New York—Market potential of approximately 1,000 F-27 turboprop transports with a dollar volume of some $700 million was forecast during the next 10 years by Fairchild Engine and Aircraft Corp. President Richard S. Boutelle during the company's annual stockholders meeting here last week.

Fairchild currently has 95 firm orders for the new twin-engine feederliner and executive transport, Boutelle noted, adding that these customers have programmed follow-on contracts for additional F-27s, bringing total of firm and expected sales to 180 airplanes.

He feels that a strong market potential also exists with the U. S. Air Force and other services. Break-even point on the F-27 currently is estimated at some 200 airplanes.

First F-27, with Rolls-Royce Dart RDa. 6 engines, will be delivered to West Coast Airlines in June 1958; first of the RDa. 7-powered F-27s will be handed over to Bonanza Air Lines in the latter part of December or early January.

First delivery of an executive airplane to Westinghouse Electric Corp. will be made late this year.

Number one prototype accumulated 12 hr. flight time as of early last week, second airplane has been rolled out and number three should be out early next month, he said. Cabin pressurization and air conditioning system, which recently completed extensive tests in a ground rig, will go into the second aircraft.

Current production schedules call for buildup of five airplanes a month in September.

Additional highlights of Fairchild's current activities:

• **Bull Goose missile** for Strategic Air Command has been flying in production configuration powered by Armstrong Siddeley Viper turbojet; next batch of production missiles will have Fairchild J83 powerplants specified for this missile.

• **A small turboprop-powered** 15-20 passenger transport of conventional configuration, is under study by Fairchild having application of "feeding the feederlines." Boutelle sees this airplane operating out of very small airports not now accessible to even the feeders.

Lycoming T53 is mentioned as a possible powerplant for this new small transport.

Feasibility of operating small turbojet engines of the J83 class at altitudes of approximately 65,000-70,000-ft. is being actively studied by Fairchild's Engine Division.

BEARING FOR THE SPACE AGE—Creation of NORTRONICS, a Division of Northrop Aircraft, Inc., forms a unique combination of scientific knowledge, development techniques, and production experience specifically required for the space age. As any long journey begins with a first step, so the conquest of space begins at sea level. Scientists and engineers of Nortronics, who created and developed the world's first successful automatic intercontinental guidance system for use within the earth's atmosphere, are now applying their knowledge and techniques on a broad front to interplanetary navigation. Daily, also, Nortronics is building "hardware," ranging from precisely-accurate guidance systems in assembly line production, through complete ground support equipment for modern missiles and ordnance. Nortronics' extensive experience, capabilities, and physical facilities are now supporting weapon systems manufacturers to provide "security with solvency" for the free world.

DIVISIONS OF NORTHROP AIRCRAFT, INC.

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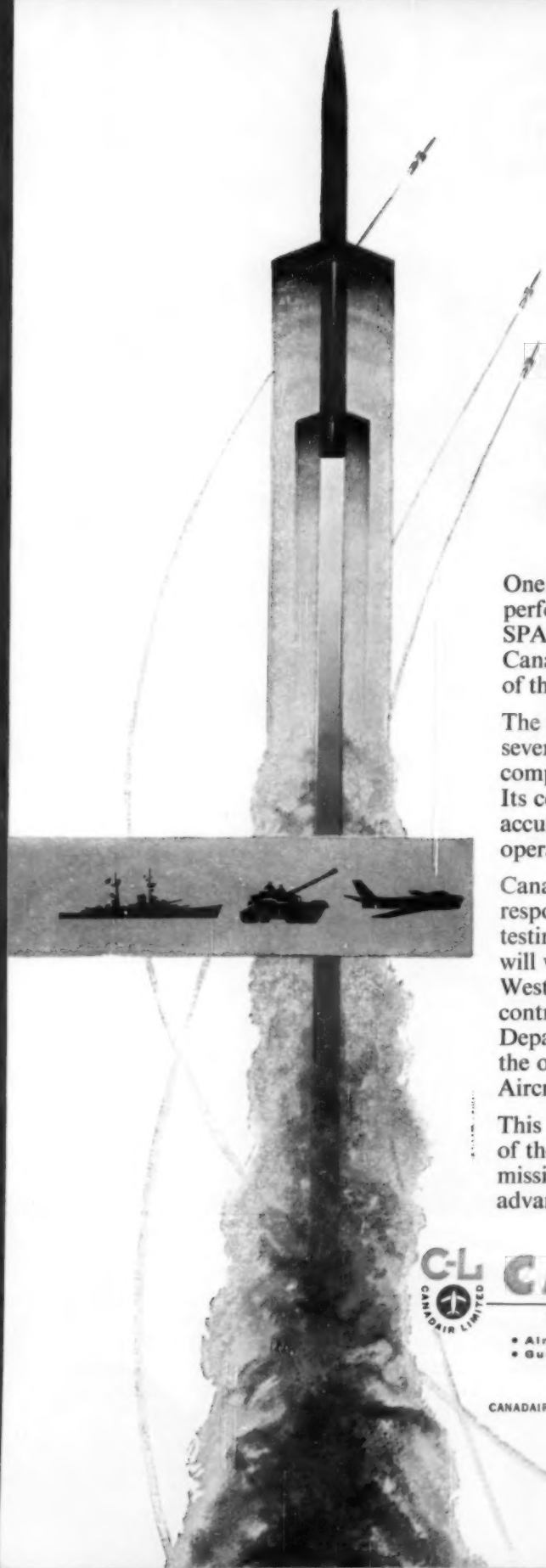
BEVERLY HILLS, CALIFORNIA, U.S.A.



FASTER
FARTHER
HIGHER

One of the world's most modern high performance air-to-air guided missiles, the SPARROW II, is going into production at Canadair for the Air Defence Command of the Royal Canadian Air Force.

The SPARROW II is rocket powered, flies at several times the speed of sound, and employs a completely self-contained radar seeking system. Its combination of speed, manoeuverability, and accuracy ranks it a match for any present manned operational aircraft.

Canadair as co-ordinating contractor, has overall responsibility for manufacture, assembly and flight testing. In producing the SPARROW II's Canadair will work in close collaboration with Canadian Westinghouse Company Limited as associate contractor, and with the R.C.A.F. and the Department of Defence Production, as well as with the original designer of the missile, Douglas Aircraft Company Inc.

This trust has been placed with Canadair because of the company's extensive experience in guided missile development, and its long record in advanced aircraft systems engineering.

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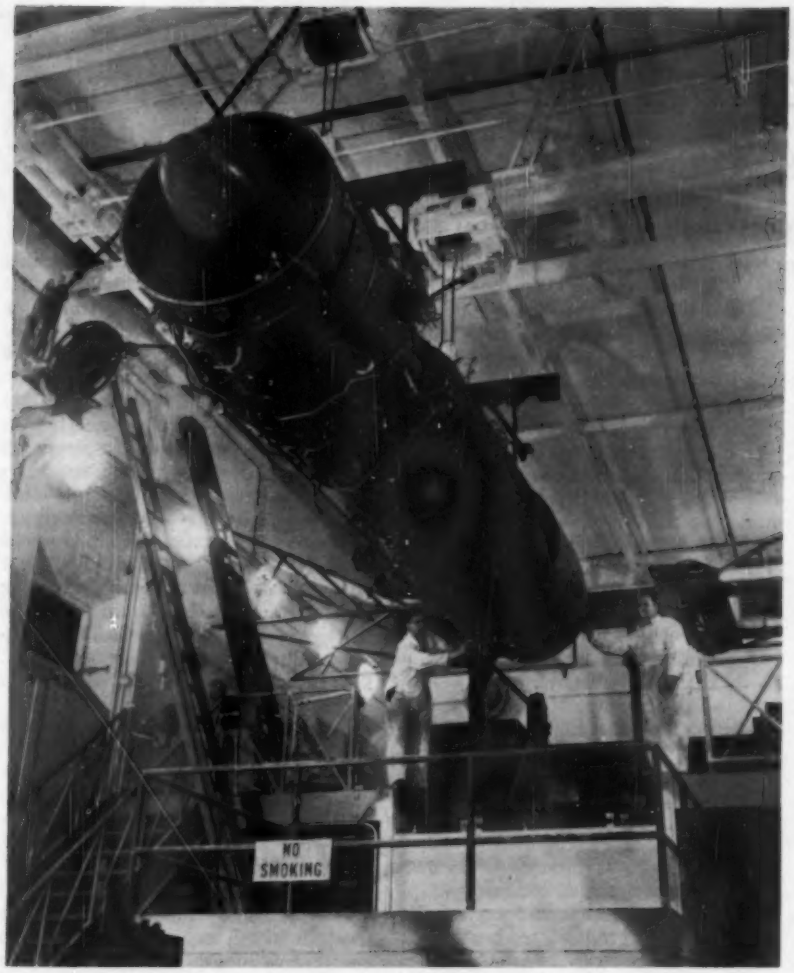

First Photo of Orenda Iroquois Prototype

First photo of prototype Orenda Iroquois shows turbojet engine without sheet metal firewall which covers fuel and hydraulic lines on underside (AW July 29, p. 26). Iroquois, which has thrust-to-weight ratio of 5 to 1 and thrust rating of more than 20,000 lb., is being flight-tested in a modified Boeing B-47 bomber. Previous photos showed mockup. National Advisory Committee for Aeronautics Laboratories, Cleveland, Ohio has tested Iroquois under high altitude and high Mach number conditions. Engine is being developed by Orenda Engines Ltd. at Malton, Ontario, Canada.

Air Force Fires Mouse 5,000 Mi.

Cape Canaveral, Fla.—Air Force fired a mouse over 5,000 mi. last week in a scaled down ICBM nose cone propelled by the first two stages of the rocket which will be used to send the first USAF reconnaissance vehicles to the vicinity of the moon.

The physiological tests on the mouse and the re-entry of the nose cone could not be considered completely successful unless the nose cone was recovered, according to Maj. Gen. Bernard A. Schriever in testimony before the Congress.

The nose cone had not been recovered late last week. However, Gen. Schriever added that a great deal of data had been telemetered to ground stations and that it would be several days before it could be reduced and analyzed.

The rocket used in the test, designated Thor Able had a Douglas Thor first stage. Second stage was an Aerojet-powered second stage of the Vanguard. This rocket, with the addition of a third stage, will be used in the Air Force moon probes. Air Force and Douglas officials indicated that the Thor Able functioned perfectly during its first flight test.

Subsequent flight tests of the Thor Able rocket will also contain small animals and various re-entry bodies to obtain as much data as possible from each firing.

News Digest

Hamilton Standard Division of United Aircraft Corp. will terminate its engineering operations in St. Petersburg, Fla., during July. Declining propeller market has caused the company to consolidate its development work in Florida with its main operation at Windsor Locks, Conn. The Florida activity was housed in 30,000 sq. ft. of leased space. Hamilton Standard also dropped plans for constructing a development and manufacturing facility near St. Petersburg, although it is retaining ownership of about 290 acres of land in the area.

First flight of Blackburn NA.39, supersonic strike aircraft for Royal Navy, was postponed last week when aircraft burst a tire during taxi trials at Bedford, England Airport. Company spokesman said prototype ran off the runway and sustained minor damage.

Airborne Instruments Laboratory, Inc., Mineola, N. Y. electronics company, has formed a space technology department under the direction of W. E. Fromm. Space group will develop electronic systems for missile and satellite projects of weapon systems contractors.

Merger discussions between Bell Helicopter Corp. and Vertol Aircraft Corp. were terminated last week by mutual consent. No reason was given for halting the talks, which had been under way since early this year (AW Feb. 3, p. 28).

Federation Aeronautique Internationale has voted to hold its 1959 General Conference in Moscow. FAI last met in Russia 23 years ago.

Traffic Control

Washington — President Eisenhower last week suspended the eight-hour day for all laborers working on the implementation of the Civil Aeronautics Administration's air traffic control system.

According to a White House spokesman, the executive order was issued because the need for immediate implementation of airways facilities has reached an "emergency state." The order does not apply to CAA personnel, only to workers assigned to actual construction of structures for the facilities.

Eisenhower, acting under a 1950 proclamation declaring a state of national emergency, designated the suspension of the restriction against overtime essential to the national defense.

Recession Hits Revenue Passenger Miles

Aviation Week survey reports first monthly drop in airline revenue passenger miles since 1949.

By L. L. Doty

Washington—Airline traffic, reacting sharply to the current economic recession, last month experienced the first monthly decline in revenue passenger miles since 1949 when the industry's post-war growth pattern began.

Although first quarter results of several carriers have not yet been released, an AVIATION WEEK survey of domestic trunklines indicates that operating revenues during the first three months of 1958 continued to climb despite the leveling-off of traffic.

Initial reports, however, indicate earnings will follow the same downward trend that has been recorded in every quarter since 1955 due primarily to a steady cost rise which the airlines have been unable to arrest. Eastern Air Lines reported a 32% drop in earnings during the first quarter as compared with the same period last year although revenues remained at approximately the same level.

Weather Factor

A few carriers attributed the poor showing in March to severe weather conditions in the eastern sector of the U. S. Delta Air Lines admitted weather slowed its efforts to develop the New York-Houston-Dallas market while Delta, Eastern, National and Northeast lost potential traffic because of a poor Florida winter season.

American said unfavorable flight conditions throughout February and March cut into revenues and Capital admitted that weather may have cost it a few percentage points in load factors during the two months. Neither Northwest nor United attributed any traffic loss to weather conditions during the first quarter.

Northeast's traffic began to climb during March, and the company reported a marked increase in Florida traffic during April. Eastern experienced an increase in revenues during March and expects April traffic to exceed April, 1957, by about 8%. Both carriers admitted that the Easter holiday aided the traffic increase.

United Air Lines said the strike against Western Air Lines by the Air Line Pilots Assn. was one of several "cushioning factors" in preventing heavy losses for the quarter. Both American and United reported that the new Civil Aeronautics Board regulation calling for a change in depreciation policy which became effective Jan. 1 had the effect of an increase in earnings.

The new regulation calls for a seven-year life in the rate of depreciation on equipment, a residual value of 15% and a "built-in overhaul" system which requires the cost of overhaul to be added to residual value. Effect of the new regulation on individual earnings of the trunklines will vary because of differences in previous accounting procedures.

For example, Eastern Air Lines prior to the revised depreciation policy had established a four-year life on equipment although the majority of carriers had adopted the seven-year life now required by the new ruling. Most carriers applied the 15% residual value while some used 10% and a few applied an even lesser amount.

The industry is unanimous in the opinion that the fare increase of approximately 6.6% has had no adverse effect on passenger traffic and called for even further increases to help offset mounting costs.

United estimated that approximately $1.7 million in additional revenue was derived from the interim fare increase but added that "this is far short of what the industry needs for economic health and the ability to maintain its present world leadership."

Braniff termed the increase insufficient but admitted that the boost had favorably effected revenues. American estimated that net earnings, after taxes, for the first quarter of 1958 "would have been approximately $850,000 greater if this fare increase had been in effect during" the entire first quarter. American's net profit for the quarter, excluding profit on the sale of property was $1,065,376 compared with $1,112,625 for same period in 1957.

A marked trend toward coach travel also was evident during the first quarter. First-class revenue passenger miles declined 4% in March and 1.1% in February. Although the increase in coach traffic subsided in line with the overall traffic decline, such traffic showed an increase of 4.1% in February over the previous February and 6.3% in March compared with the same month last year.

Coach passenger miles, related to total passenger miles, have almost reached 40%. For the year ended March, 1953, coach travel accounted for only 21% of total traffic while, for the 12 months ended March, 1958, such traffic accounted for 39.23% of total traffic.

Coach available seat miles increased 10.6% in March over the same month last year and an 11.1% rise was reported in February. First-class available seat miles dropped .6% in March and climbed only 4% in February.

Available seat miles for all types of traffic rose only slightly during the first three months compared to a consistently high monthly increase during the past eight years. For example, in March, capacity climbed only 3.4% over March, 1957, compared to a 24% increase in that month over March, 1956.

Most carriers attribute the drop-off in capacity to a tightening of schedules because of increased competition on major routes and a resultant decline in load factors.

Load Factor Off

A March load factor of 58.6% was 2.14 points below that registered in the previous March and represents the sixth consecutive month in which trunkline load factors were less than 59%.

Chances that available seat miles during the balance of the year will increase as in the past are not likely. A total of 50 piston engine aircraft are scheduled to be delivered in 1958 to the trunklines compared to 129 last year. A number of carriers are planning to dispose of a portion of their piston-engine fleets this year in preparation for turbine powered aircraft.

Revenue passenger miles dropped .2% in March over the previous March. An increase of .8% was registered in February and a 9.3% increase was recorded in January. Biggest revenue passenger mile loss was shown in the first-class category with a 4% decline in March and a 1.1% decline in February. These losses were offset by a 6.3% increase in coach revenue passenger miles during March and a 4.1% increase during February.

Major problem facing the trunklines this year involves the continuing rise of the overall expenses level. According to Ralph A. Courtney, Jr., senior associate of Planning Research Corp., economic consultant firm, airline costs for products and services have risen an average 45% since 1947 compared to a 22% in-

New Strike Threat

Washington—Air Line Pilots Assn. last week voted to authorize a strike against North Central Airlines after negotiations on pay and working conditions broke off in Chicago.

Meanwhile, no settlement had been reached in the ALPA strike against Western Air Lines as of late last week. However, Western submitted a proposal to the National Mediation Board suggesting the appointment of a six-man fact finding board to review all issues in the strike except that pertaining to the crew composition of the turboprop Electras Western has on order.

The proposal would permit Western to resume operations and would give pilots the opportunity to re-open the third-man crew issue 60 days prior to the inauguration of scheduled turboprop service. American Airlines and ALPA were still in negotiation under the jurisdiction of an emergency fact finding board late last week.

crease in general consumer prices and a 28% climb in industrial prices during the same period. Testifying in the public hearing of the CAB's General Passenger Fare Investigation, Courtney said airline salaries have jumped 78% in the last decade and that fuel and oil prices have climbed 41%.

In addition to the general cost rise, airlines will soon be forced to face a high interest expense on long-term loans covering the purchase of turbojet and turboprop transports.

Most economists see no immediate end to the present rise in expenses. According to Dr. Philip Neff, an economics analyst testifying for the Air Transport Assn. at the fare investigation, the next 20 years—like the last 20—will be a period of rising prices.

Minetti Explains Fare Defense

Washington — Civil Aeronautics Board approval of the recent 6% interim fare increase for domestic carriers "threatens to kill the goose that laid the golden egg," CAB member G. Joseph Minetti charged last week.

In a 25 page dissenting opinion, Minetti questioned the wisdom of the fare approval during the current recession and repeated his opposition to any increase prior to completion of the complicated General Passenger Fare Investigation now under way.

While the questions he raised and his answering remarks were based on the interim increase, Minetti admits that they have a bearing on the larger hearing, but he carefully points out that his dissent would in no way "prejudge" issues in the general fare investigation.

An advocate of low-cost air coach service, Minetti criticized the failure of his fellow Board members to restrict the increase to first-class fares only as a means of avoiding the loss of markets and maintaining a steady growth.

Minetti said price is the key to the exclusive "mass market" long sought by the airlines, but he cautioned that fare increases would have a "dangerously retarding effect" on the untapped revenue from a large segment of Americans who have never flown. He estimates the percentage at 75%.

"In my opinion, this is a short-sighted way of doing business," he said.

As an indication of "buyer resistance," Minetti cited the rapid percentage gain of coach travel over first class experienced by the domestic trunk lines during the latter part of 1957. In March, 1957, first class and coach growth bore a two-one ratio to one another. This figure changed to a one-three ratio by December.

He considered the figures significant because first-class traffic was declining while coach growth was rising during a period when many major markets were offered "apparently inadequate" levels.

Minetti says he regards jet equipment plans of the major carriers as a "pivotal issue" against any fare increase at present. He believes that, overshadowing the problem of financing the expanded fleet, is the problem of "filling the huge number of present and anticipated additional seats."

"The effect of prices on traffic is a critical question facing the Board and the industry," he warned. "Not only is today's rate of equipment addition far outstripping actual or anticipated rates of traffic growth, but the greatly accelerated growth of capacity, commencing with delivery of the turbine powered transports, will swell the problem to crisis proportions."

Recalling that CAB approval of the interim fare increase was based partially on the reflection of actual capacity reported by the carriers, Minetti termed the applicants as "sole arbiters" of fare levels and predicted that any further capacity increases prior to a decision in the general fare investigation would automatically call for another fare increase.

He said that approval of the increase, based on this premise, is not in agreement with Section 1002 of the Civil Aeronautics Act which charges the CAB with responsibility of judging fare levels on the basis of the effect of rates upon traffic movement and the public need for low cost air transportation.

What is needed, he said, is a balanced traffic-growth capacity. An excess of capacity, he added was "almost solely responsible" for decline in earnings.

IATA Sets Sandwich Configuration

New York—Hearings on charges against four transatlantic airlines accused of over-feeding their economy-class passengers resulted last week in a new, detailed definition of the sandwich.

In a related but separate matter at the International Air Transport Assn. hearing in London, Scandinavian Airlines System reportedly was fined $20,000.

Air France, KLM Royal Dutch Airlines, SAS and Swissair were defendants before IATA's breaches commission against complaints made by Pan American World Airways and Trans World Airlines. The accused carriers all report that the new definition of economy class service will mean little or no change in their food offerings. The hearing was a development in the "sandwich war" which has hit the Atlantic run this year with introduction of the economy low-fare service, which is limited by agreement in the type of food service which can be provided.

IATA enforcement matters are generally kept strictly within the industry, but the sandwich war has attracted considerable public interest. While neither IATA nor SAS will comment on the matter, Aviation Week has learned that the $20,000 fine was assessed against the airline in connection with certain material sent to travel agents.

The bulletin contained a sentence which said SAS's economy food service wouldn't consist of any doughy, cellophane wrapped indigestibles, and SAS was accused of knocking the competition. The airline maintains, however, that the reference was to a type of mass-produced sandwich and not to any competitor, according to industry sources. These sources report that SAS will seek a reversal of the decision.

The hearing was the second round for SAS in the sandwich war. About two months ago the airline was the sole defendant before IATA against complaints that it planned a too-elaborate food service. No action was taken, however.

Lest a sandwich by any other name be not the same, the IATA commission soberly spelled out exactly what was meant, including the requirement that each sandwich be a separate unit with "a substantial and visible part" consisting of "bread, roll or similar breadlike material." Forbidden in the definition were such ingredients as caviar, game, asparagus and pate.

Collision Spurs New Demands For Positive Traffic Control

Washington—Congressional pressure for tighter control of air space mounted rapidly last week in the wake of a mid-air collision between a United Air Lines DC-7 and an Air Force F-100F near Las Vegas, Nev.

At the same time, the Civil Aeronautics Board spurred its drive for positive control of airways as a major safeguard against mid-air collisions but admitted it would be several years at least before an all-weather traffic control plan can be implemented. According to Oscar Bakke, director of CAB's Bureau of Safety, lack of "men, money and machines" now bar the way to an adequate, nation-wide control system.

Last week's accident is the fourth mid-air collision in the southwest area of the U. S. within the last two years. On June 30, 1956, a United Air Lines DC-7 and a TWA Constellation 1049G collided over the Grand Canyon. A DC-7B and a Northrop F-89J collided in January last year near Van Nuys, Calif., and on Feb. 1, 1957, a Military Air Transport Service DC-6 and a Navy P2V were involved in a mid-air collision near Los Alamitos, Calif.

Strong congressional reaction to the Grand Canyon accident prompted a sizeable increase in funds allocated to the Civil Aeronautics Administration for the establishment of air navigation facilities. Original appropriations amounting to $40 million for fiscal year 1957 were immediately boosted to $75 million by a Congress reawakened to the need for a better air traffic control system.

In Fiscal 1958, budget appropriations were $140 million and the President has recommended $175 million for Fiscal 1959.

Late last week, Congress again was urging additional funds to support an improved air traffic control system. Rep. Harry G. Haskell Jr. (R.-Del.) said: "This tragic accident underlines all too clearly the urgent need to provide the Civil Aeronautics Administration with adequate funds to improve and develop a safe air traffic system useable by both military and civilian aviation interests."

Sen. A. S. Mike Monroney (R.-Okla.) called for "absolute instrument control" of all aircraft, and Rep. Patrick Hillings (R.-Cal.) warned that the traffic control problem cannot be settled "as long as the military or military thinking dominates aviation agencies . . . within the federal government."

Most airline operaters agree that the best protection against mid-air collisions under the present state of the art is positive control of traffic. Although much progress has been made toward such a system during the past two years, there is now no en route positive traffic control on any U. S. airways nor is there likely to be until a system of long-range radar is implemented.

CAA's five-year plan calls for a total of 73 long-range radars by 1962 but has estimated that such a project can be completed by the end of 1959 if $33.6 million is made available to it. However, the administration's current budget asks for only $25.6 million for these facilities.

Subsidy Asked

Washington—AAXICO airlines has become the third all-cargo carrier to request subsidy relief from the Civil Aeronautics Board within the last two months.

Filing of the airline's plea highlights the financial predicament of the four domestic all-cargo certificate holders and their nine year experiment in air freight operations (AW April 7, p. 38). Flying Tiger is the one remaining carrier that has not yet sought subsidy, although it has indicated that conditions may force such a decision in the near future. Riddle Airlines applied for subsidy in March. Slick Airways has applied for a one-year suspension of service, followed with a subsidy request on April 3.

AAXICO's request echoes those of the other applicants in placing the blame for their demise on the current business recession, a lack of lucrative routes and obsolete flight equipment.

The airline estimated a subsidy payment of $35,000 a month would be needed to counteract its operational losses. Revenues dropped from $57,000 for the month of December to only $40,000 in January, the carrier said.

AAXICO said refusal of the Civil Aeronautics Board to grant the airline authority to serve the Great Lakes area from Atlanta left the airline with "doubtless the leanest cargo route" certificated to any of the all cargo carriers.

A need for new flight equipment is one of the major causes for its present plight the airline said, observing that unless better aircraft are obtained "we are doomed to failure." AAXICO's entire equity is tied up in a fleet of 37 Curtiss C-46s which have experienced a drastic drop in market value from $135,000 to only $75,000 today, the carrier stated.

Here are the steps taken in recent years toward more positive control of traffic by revising regulations:

- **Civil Aeronautics Board** authorized the Civil Aeronautics Administrator to designate restricted areas for military operations when he "finds a hazard to aircraft in flight exists." On April 1, Halford P. Noggle took over the new position of assistant administrator for airspace for the CAA. As of last week, the newly organized office had made no decisions on any case involving the allocation of airspace.
- **CAA established control** of airspace throughout the U. S. at altitudes above 24,000 ft. beginning last Dec. 1. Such airspace cannot be considered as being under "positive" control since the ruling does not restrict aircraft flying VFR under VFR conditions. The ruling essentially requires aircraft filing IFR flight plans to follow established airways above 24,000 ft. CAA plans to lower the floor to 15,000 ft. later this year.
- **Air Line Pilots Assn.** last year inaugurated the use of instrument flight rules under all weather conditions at altitudes above 9,500 ft. on the "Golden Triangle" routes between New York, Washington and Chicago. This voluntary action again cannot be classified as "positive" control since other aircraft are not placed under similar restrictions.
- **U. S. carriers require IFR** operations on all routes above 18,000 ft. under all weather conditions. "See and be seen" principle of flight, however, would apply to the air carriers in avoidance of mid-air collisions with VFR flights.
- **Following the mid-air collision** near Van Nuys in February, 1957, Civil Aeronautics Board empowered the Civil Aeronautics Administrator to approve and designate flight tests areas over open water and sparsely settled areas in a move to prevent a recurrence of collisions with test flights operated by manufacturers or the military services.

Latest effort to bring positive control of air traffic into effect came last week with a proposed ruling issued by the CAB. Final discussions of the new ruling by Board members coincided with the Las Vegas accident Monday and announcement of the regulation followed within hours of the accident.

Basically, the regulation authorizes the CAA to designate as a "positive control route segment" any portion of the airspace in the U.S. between 20,000 ft. and 35,000 ft. Such segments will not exceed 40 mi. in width. The ruling prohibits VFR flights in the area irrespective of weather and bans all aircraft not holding flight approval of air traffic control.

According to the CAB, the program is entirely experimental and will be applied for evaluation and study.

Airlines Report Executive Pay, Bonuses

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensations, expenses and stock holdings compiled from airline reports to the Civil Aeronautics Board.

Trunk Airlines

BRANIFF AIRWAYS INC.—**C. E. Beard,** president, $69,000 salary, $5,078 bonus and indirect compensation and 21,600 shares of common stock; **J. W. Miller,** executive vice president, $44,500 salary, $3,203 bonus and indirect compensation and 1,206 shares of common stock; **C. G. Adams,** vice president finance and treasurer, $32,250 salary, $2,284 bonus and indirect compensation and 6,759 shares of common stock; **R. C. Shrader,** vice president, $18,000 salary, $1,215 bonus and indirect compensation and 8,266 shares of common stock; **R. V. Carlton,** vice president—operations, $34,500 salary, $2,453 bonus and indirect compensation and 4,000 shares of common stock; **R. Brack,** vice president—traffic and sales, $23,000 salary, $1,590 bonus and indirect compensation and 300 shares of common stock; **M. Harrison,** vice president—industrial relations, $19,500 salary, $1,328 bonus and indirect compensation, no stock.

W. Henshel, vice president—public relations, $19,500 salary, $1,328 bonus and indirect compensation and 100 shares of common stock; **V. A. Kropff,** assistant vice president—executive projects, $13,050 salary, $843 bonus and indirect compensation, no stock; **O. W. Crane,** treasurer, $14,306 salary, $938 bonus and indirect compensation and 213 shares of common stock; **R. L. Barrier,** assistant treasurer and budget director, $11,250 salary, $709 bonus and indirect compensation, no stock; **F. J. Beisecker,** assistant treasurer, $11,250 salary, no bonus and 500 shares of common stock; **L. Eden,** assistant treasurer, $11,250 salary, $709 bonus and indirect compensation and 100 shares of common stock; **V. Bowlware,** assistant secretary, $5,205 salary, $241 bonus and indirect compensation and 40 shares of common stock; **H. M. Bolding,** vice president—purchasing and stores, $11,850 salary, $754 bonus and indirect compensation and 164 shares of common stock.

F. Jones, director, no salary, $600 bonus and indirect compensation and 2,132 shares of common stock; **G. Butler,** director, no salary, $200 bonus and indirect compensation and 10,720 shares of common stock; **R. J. Whiteford,** director, no salary, $600 bonus and indirect compensation and 1,120 shares of common stock; **W. A. Blakley,** director, no salary, $600 bonus and indirect compensation and 517,955 shares of common stock; **E. C. Eppley,** director, no salary, no bonus and 16,121 shares of common stock.

T. N. Law, director, no salary, $600 bonus and indirect compensation and 130 shares of common stock; **G. D. Murdoch,** director, no salary, $600 bonus and indirect compensation and 1,400 shares of common stock; **W. W. Flenniken,** director, no salary, $600 bonus and indirect compensation and 100 shares of common stock; **M. McGreevy,** director, no salary, $400 bonus and indirect compensation and 2,500 shares of common stock; **J. H. Walker,** director, no salary, $200 bonus and indirect compensation and 100 shares of common stock; **Whiteford, Hart, Carmody & Wilson** legal services, $66,000.

CONTINENTAL AIR LINES INC.—**L. H. Mueller,** chairman, board of directors, no salary, $200 bonus and indirect compensation and 31,395 shares of common stock; **R. F. Six,** president, $55,000 salary, no bonus and 5,250 shares of common stock; **L. C. Ames,** director, no salary, $200 bonus and indirect compensation and 12,600 shares of common stock; **S. G. Cooper,** director, no salary, $200 bonus and indirect compensation and 2,625 shares of common stock; **F. L. Ehrman,** director, no salary, $200 bonus and indirect compensation, no stock; **M. F. Hellman,** director, no salary, $200 bonus and indirect compensation, no stock; **J. G. Holland,** director, no salary, $200 bonus and indirect compensation and 3,255 shares of common stock; **F. H. Ricketson,** director, no salary, $200 bonus and indirect compensation and 6,090 shares of common stock; **T. Roberts,** director, no salary, no bonus and 64,152 shares of common stock; **B. J. Smith,** director, no salary, $100 bonus and indirect compensation and no stock.

J. A. Uhl, vice president, treasurer and director, $22,000 salary, no bonus and 3,947 shares of common stock; **C. C. West,** vice president and director, $30,000 salary, no bonus and 4,100 shares of common stock; **O. R. Haueter,** vice president—operations, $25,000 salary, no bonus and 2,166 shares of common stock; **L. H. Dennis,** vice president—passenger service, $18,500 salary, no bonus and 945 shares of common stock; **S. O. Halberg,** vice president—public relations and advertising, $14,500 salary, no bonus and 1,155 shares of common stock; **H. L. Lawrence,** executive vice president—administration and sales, $20,000 salary, no bonus and no stock; **C. H. Calhoun,** vice president—engineering and maintenance, $18,500 salary, no bonus and 210 shares of common stock; **H. F. Seifert,** vice president—operations administration, $15,500 salary, no bonus and 10 shares of common stock; **S. B. Redmond,** secretary, $14,000 salary, no bonus and 1,443 shares of common stock.

P. F. Kriethe, assistant secretary, $10,500 salary, no bonus and five shares of common stock; **A. O. Beckman,** director, no salary, $100 bonus and indirect compensation and no stock; **W. P. Paepcke,** director, no salary, $100 bonus and indirect compensation, no stock; **R. Stewart,** director, no salary, $100 bonus and indirect compensation and 105 shares of common stock.

Cooper, White & Cooper, legal services, $35,486; **Holland & Hart,** legal services, $16,241; **Leasure & Scheurer,** legal services, $37,145; **Peat, Marwick & Mitchell,** auditing services, $8,272; **Walker & Crenshaw,** auditing services, $38,289; **Charles Butler & Associates,** consultants, $11,636; **Galen E. Broyles & Co.,** advertising services, $364,906; **Lennen & Newall, Inc.,** advertising services, $30,619; **City and County of Denver, Colo.,** airport improvements (survey for jet aircraft), $6,870; **Boulder Travel Agency,** commissions, $7,450; **Guide Travel Systems,** commissions, $8,025; **Lones Travel Service,** commissions, $5,798; **World Wide Travel System,** commissions, $10,032; **Travel Service Everywhere,** commissions, $5,244; **Zay Smith & Associates,** $6,671; **Pereira & Luckman,** engineering services, $10,710; **Paul R. Reddy,** engineering services, $5,849.

DELTA AIR LINES INC.—**C. E. Woolman,** president, general manager and director, $56,000 salary and 41,196 shares of common stock; **L. C. Parker,** vice president—traffic and sales and director, $29,867 salary and 1,875 shares of common stock; **C. H. Dolson,** vice president—operations and director, $29,867 salary and 1,625 shares of common stock; **T. G. Cole,** vice president—administration and finance and director, $27,292 salary and 791 shares of common stock; **R. S. Maurer,** vice president—legal and director, $20,800 salary and 98 shares of common stock; **W. T. Beebe,** vice president—personnel, $19,733 salary and 112 shares of common stock.

E. Cocke Jr., vice president—civil affairs, $19,413 salary and 1,300 shares of common stock; **T. M. Miller,** assistant vice president—traffic and sales, $19,413 and

MATS Contracts

Washington—Following is a list of Military Air Transport Service contracts awarded for commercial airlift in Fiscal 1956, 1957 and 1958 as supplied to a subcommittee of the House Committee on Government Operations:

	FY 1956	FY 1957	FY 1958 (July Through March)
California Eastern Aviation	$4,478,186	$4,687,054	$3,517,261
Capitol Airways	596,244	1,964,454	1,361,704
CAT Inc.	.....	110,130	.....
Central Air Transport	396,200	448,429	42,800
Flying Tiger Line	3,023,673	6,539,141	13,931,961
General Airways	31,065	54,761	.....
Great Lakes Airlines	2,138,371	728,598	.....
Los Angeles Air Service	922,350	101,424	.....
Meteor Air Transport	360,473	17,076	.....
Northwest Airlines	555,258	461,187	13,650
Overseas National Airways	3,016,079	2,288,718	41,390
Pacific Northern	.....	11,250	.....
Pan American World Airways	3,822,909	5,294,216	2,903,902
Peninsular Air Transport	202,273	.....	.....
Resort Airlines	253,315	1,810,322	154,694
Seaboard & Western Airlines	10,117,492	10,256,172	8,270,157
Slick Airways	4,265,934	8,459,104	5,395,944
Trans Caribbean Airways	728,257	879,337	.....
Transocean Airlines	1,222,338	2,709,143	1,321,968
Trans World Airlines	333,236	513,577	1,146,899
Twentieth Century Airlines	3,512,188	259,435	.....
U. S. Overseas Airlines	1,744,081	572,412	.....
United Air Lines	99,761	4,840	.....
Viking Air Lines	1,097,163	.....	.....
World Airways	.....	1,369,153	1,698,216
Total	$43,269,349	$49,746,935	$39,800,547

FOR MEDIUM/LONG RANGE
AIRLINERS

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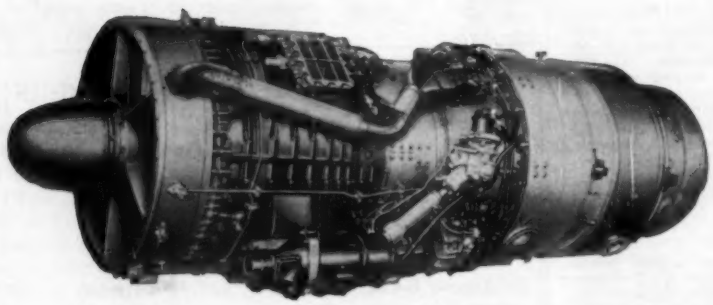

The Civil Avon powers the de Havilland Comets ordered by British Overseas Airways Corporation and British European Airways and the Sud-Aviation Caravelles ordered by Air France, Scandinavian Airlines System, S.A. Empresa de Viacao Aerea Rio Grandense (VARIG), Aero Osakeyhtio (Aero O-Y Finnair.) and Air Algerie

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75 shares of common stock; **R. H. Wharton**, assistant vice president—personnel, $12,800 salary and 250 shares of common stock; **C. H. McHenry**, secretary-treasurer and director, $1,280 and 1,875 shares of common stock; **H. H. Saxon**, assistant treasurer, $11,100 salary, no stock; **J. E. Howell**, assistant treasurer, $10,374 salary, no stock; **R. W. Freeman**, chairman, board of directors, $1,280 salary and 8,950 shares of common stock; **R. W. Courts**, director, no salary and no stock; **E. H. Gerry**, director, no salary and 1,175 shares of common stock.

J. R. Longmire, director, no salary and 2,500 shares of common stock; **W. Nunnally**, director, no salary and 13,000 shares of common stock; **C. Putnam**, director, no salary and no stock; **R. J. Reynolds**, director, no salary and 122,500 shares of common stock; **J. W. Rodgers**, director, no salary and 1,000 shares of common stock; **A. Anderson & Co.**, auditing and tax services, $15,302; **Pogue & Neal**, legal services, $32,211; **Alvord & Alvord**, legal services, $5,023; **Cresap-McCormic & Paget**, management consultants, $44,884; **S. H. Stewart**, special and professional services, $10,000; **Ernst & Ernst**, management consultants, $25,344; **Laso Y. Cubas**, legal services, $6,826; **Turner, Rodgers, Winn, Scurlock & Terry**, legal services, $7,593; **F. M. Long**, legal services, $5,000.

NATIONAL AIRLINES INC.—G. T. Baker, president and director, $39,000 salary, $49,809 bonus and indirect compensation, $3,231 expenses paid by company and 162,939 shares of common stock; **J. C. Brawner**, senior vice president and director, $19,500 salary, $25,531 bonus and indirect compensation, $1,473 expenses paid by company and 3,200 shares of common stock; **C. E. Banks**, assistant vice president, $6,000, no bonus, $42 expenses paid by company and 200 shares of common stock; **W. B. Caldwell**, assistant treasurer, $10,998 salary, $6,065 bonus and indirect compensation, $1,342 expenses paid by company and 50 shares of common stock; **L. W. Dymond**, vice president, $16,000 salary, $17,508 bonus and indirect compensation, $531 expenses paid by company and 300 shares of common stock; **R. A. Fitzgerald**, vice president, $13,500 salary, $16,067 bonus and indirect compensation, $73 expenses paid by company and 200 shares of common stock; **R. P. Foreman**, secretary and director, $13,500 salary, $20,425 bonus and indirect compensation, $2,356 expenses paid by company and 4,000 shares of common stock.

S. Gewirtz, vice president, $16,500 salary, $7,386 bonus and indirect compensation, $3,261 expenses paid by company, no stock; **R. S. Grant**, assistant vice president, $13,500 salary, $10,085 bonus and indirect compensation, $682 expenses paid by company and 75 shares of common stock; **A. G. Hardy**, senior vice president, $19,500 salary, $25,531 bonus and indirect compensation, $3,178 expenses paid by company and 1,100 shares of common stock; **W. F. Johnson**, assistant secretary and treasurer, $13,000 salary, $18,723 bonus and indirect compensation, $856 expenses paid by company and 3,305 shares of common stock; **J. L. Morris**, vice president, $13,500 salary, $20,425 bonus and indirect compensation, $3,942 expenses paid by company and 3,010 shares of common stock; **G. W. Paul**, assistant vice president, $12,000 salary, $436 bonus and indirect compensation, $1,428 expenses paid by company and 75 shares of common stock.

W. A. Perry, assistant vice president, $13,500 salary, $12,255 bonus and indirect compensation, $2,012 expenses paid by company and 200 shares of common stock; **H. K. Pike**, vice president, $13,500 salary, $17,508 bonus and indirect compensation, no expenses and 75 shares of common stock; **J. M. Rosenthal**, senior vice president, $19,500 salary, $25,531 bonus and indirect compensation, $1,875 expenses paid by company and 3,500 shares of common stock; **C. F. Sharp**, assistant vice president, $12,000 salary, $12,255 bonus and indirect compensation, $1,330 expenses paid by company and 1,000 shares of common stock; **W. Sternberg**, senior vice president, $18,000 salary, $10,699 bonus and indirect compensation, $4,818 expenses paid by company and 131 shares of common stock.

R. E. Wieland, vice president, $13,500 salary, $20,425 bonus and indirect compensation, $1,392 expenses paid by company and 3,408 shares of common stock.

The following have no salary, no bonus and no expenses: **J. W. Cross**, director, 500 shares of common stock; **G. M. Gibbs, Jr.**, director, 60 shares of common stock; **B. O. Hedges**, director, 300 shares of common stock; **E. C. McDonald**, director, 775 shares of common stock; **P. R. Scott**, director, 3,000 shares of common stock; **D. R. Topping**, director, 500 shares of common stock; **J. A. Watterman**, director, 506 shares of common stock; **B. Winters**, director, no stock.

Denning & Wohlsetter, legal services, $6,476; **John W. Cross**, legal services, $42,-219; **Scott, McCarthy, Preston, Steel & Gilleland**, legal services, $41,453; **Gotch & Crawford**, statistical services, $5,883; **Mayo Clinic**, medical services, $9,213; **Johns Hopkins Hospital**, medical services, $15,317; **Fischer Ryon**, medical services, $5,747; **Alexander & Alexander**, actuarial services, $9,771; **Albert E. Blomquest & Associates**, engineering services, $12,637; **Jack Darling**, catering services, $6,500; **Investigators Inc.**, management research, $24,591; **David L. Cole**, arbitration, $7,172; **Haskins & Sells**, auditing services, $12,575.

NORTHEAST AIRLINES INC.—J. W. Austin, executive vice president, $2,032 salary, no bonus and no stock; **N. B. Fry**, vice president—traffic and sales, $1,129 salary, no bonus and no stock (both Austin, who is now president of Northeast, and Fry joined the airline in December.); **G. E. Gardner**, president and director, $25,076 salary, $5,000 bonus and indirect compensation and 16,000 shares of common stock; **H. Heard**, treasurer and vice president—administration and finance, $15,000 salary, $1,500 bonus and indirect compensation and 3,000 shares of common stock; **R. H. Kerr**, vice president—personnel, $11,800 salary, $1,000 bonus and indirect compensation and no stock; **A. A. Lane**, vice president—operations, $17,500 salary, $1,500 bonus and indirect compensation and 4,010 shares of common stock; **R. P. Lane, Jr.**, comptroller-treasurer, $10,000 salary, no bonus or stock; **D. W. H. MacKinnon**, vice president—engineering and maintenance, $14,750 salary, $1,500 bonus and indirect compensation and 5,000 shares of common stock; **W. W. Mies**, assistant vice president—engineering and maintenance, $10,308 salary, $250 bonus and indirect compensation and 100 shares of common stock.

J. F. Molloy, assistant vice president—administration and finance, $8,250 salary, no bonus or stock; **G. E. Reed**, assistant treasurer, $9,300 salary, $125 bonus and indirect compensation and no stock; **P. F. Collins**, chairman, board of directors, no salary, no bonus and 1,000 shares of common stock.

Following persons have no salary or bonus: **J. Cochran**, director, 1,000 shares of common stock; **J. F. Fitzgerald**, director, 500 shares of common stock; **H. E. Foley**, clerk of corporation, 900 shares of common stock; **A. D. McMenimen**, director, 100 shares of common stock; **R. Irimescu**, director, 300 shares of common stock; **C. Peterson**, assistant clerk of corporation, no stock; **E. L. Vidal**, director, 12,000 shares of common stock; **L. F. Whittemore**, director, 100 shares of common stock.

Folley, Hoag & Eliot, legal services, $84,-500; **Lybrand, Ross Bros. & Montgomery**, accounting services, $35,760; **Walton, Lantaff, Schroeder, Atkins, Carson & Wall**, legal services, $6,675; **J. Walter Thompson Co.**, advertising services, $57,628; **Chambers & Wiswell**, advertising services, $945,096; **R. Dixon Speas Associates**, aircraft consultants, $13,609; **Charles Butler Associates**, design consultants, $11,293; **Gus W. Campbell**, management consultants, $5,728; **Dickie-Raymond Inc.**, advertising services, $12,056.

NORTHWEST AIRLINES INC. — C. Hunter, chairman, board of directors, $50,-000 salary and 8,300 shares of common stock; **D. Nyrop**, president and director, $52,000 salary and 2,000 shares of common stock; **M. S. Mackay**, executive vice president and director, $30,000 salary and 1,200 shares of common stock and 2,000 4.6% preferred shares. **F. C. Judd**, vice president—operations and engineering, $26,250 salary and five shares of common stock; **G. M. Bain**, vice president—sales, $26,250 salary and no stock.

L. C. Gotzbach, vice president—personnel, $23,000 salary and five shares of common stock; **A. E. Flaan**, vice president and secretary (resigned as director 7/8/57), $22,000 salary and five shares of common stock; **L. S. Holstad**, comptroller, $20,000 salary and 305 shares of common stock; **W. J. Eiden**, treasurer, $21,250 salary and four shares of common stock; **A. D. Piepgras**, assistant comptroller, $12,000 salary and no stock; **D. H. Hardesty**, assistant treasurer, $12,000 salary and 10 shares of common stock; **D. Merrick**, assistant vice president—properties, $13,000 salary and no stock; **G. L. Stewart**, assistant vice president—plans, $15,750 salary and 47½ shares of common stock; **P. L. Benscoter**, vice president—Orient Region, $15,750 salary and no stock.

F. J. Scott, assistant secretary, $10,100 salary and no stock; **P. T. Drotning**, vice president—public relations, $18,000 salary, no stock; **W. Stern**, director, $10,600 salary and 200 shares of common stock; **J. H. Binger**, director, $900 salary and 2,926 shares of common stock; **M. H. Fry**, director, $1,000 salary and 2,000 shares of common stock; **R. M. Hardy**, director, no salary or stock; **J. T. Johnson**, director, $1,000 salary and 900 shares common stock; **A. Petteys**, director, $900 salary, 11,000 shares of common stock and 2,500 4.6% preferred shares; **C. F. Reavis**, director, $400 salary and 3,500 shares of common stock; **A. G. Redpath**, director, $700 salary and 1,000 shares of common stock; **L. E. Wakefield, Jr.**, director, $1,000 salary and 750 shares of common stock.

A. J. Weatherhead, director, $300 salary and 2,650 shares of common stock; **H. Case**, director, $300 salary and no stock; **T. B. Gamble**, director, $500 salary and no stock; **C. B. Morgan**, director, $500 salary and no stock; **W. Whitney**, director (deceased 3/28/57), $100 salary and no stock; **Dorsey, Owen, Barker, Scott & Barker**, legal services, $15,497; **Ernst & Ernst**, accounting services, $20,983; **Harold R. Harris**, payment to former president, $10,000; **Hodges, Reams, McGrath & Downey**, legal services, $20,304; **Koteen & Burt**, legal services, $24,887; **C. Edward Leasure**, legal services, $54,518; **Mayo Clinic**, medical services, $6,656. A total of 25,000 shares of common stock are beneficially owned by a company of which **M. H. Fry**, director, is president, director and stockholder; 81,306 shares of common stock are beneficially owned by company of which **H. Case**, director, is president.

International

CARIBBEAN ATLANTIC AIRLINES INC.—D. Trigo, president, $16,500 salary, no bonus and 23,397 shares of common stock; **B. Trigo**, vice president, $6,500 salary, no bonus and 23,397 shares of common stock; **J. M. Sierra**, vice president—operations, $13,000 salary, $850 bonus and indirect compensation and 108 shares of common stock; **R. B. Forrest**, vice president—traffic, $16,000 salary, $650 bonus and indirect compensation and four shares of common stock; **L. A. Lockhart**, treasurer, $10,000 salary, $575 bonus and indirect compensation and 260 shares of common stock; **A. Valdes, secretary**, $8,600 salary, no bonus and 80 shares of common stock; **M. J. Fernandez**, director, no salary, no bonus and 1,597 shares of common stock; **J. Trigo**, director, no salary, no bonus and 17,876 shares of common stock.

J. Caber, director, no salary, no bonus and 708 shares of common stock; **F. Ballester**, director, no salary, no bonus and 435 shares of common stock; **C. B. Francois**, director, no salary, no bonus and 1,726 shares of common stock; **H. L. Kimelman**, director, no salary, no bonus and 10,100 shares of common stock; **Whiteford, Hart, Carmody & Wilson**, legal services, $10,671.

Local Service

PIEDMONT AVIATION INC.—T. H. Davis, president, treasurer and director, $20,004 salary, no bonus, $4,401 expenses

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DES MOINES

paid by company and 115,721 shares of common stock; **C. G. Brown Jr.,** vice president, $10,600 salary, no bonus, $1,048 expenses paid by company and 4,200 shares of common stock; **H. K. Saunders,** vice president and director, $15,000 no bonus, $249 expenses paid by company and 5,250 shares of common stock; **R. S. Northington,** vice president and director, $9,592 salary, no bonus, $2,114 expenses paid by company and 6,900 shares of common stock; **M. F. Fare,** secretary and director, $9,850 salary, no bonus, $1,491 expenses paid by company and 5,651 shares of common stock.

The following persons were not paid a salary or expenses: **G. E. Anderson,** director, $125 bonus and indirect compensation and 100 shares of common stock; **E. L. Davis Jr.,** director, $125 bonus and indirect compensation and 7,500 shares of common stock; **T. Dowd,** director, $50 bonus and indirect compensation and 1,000 shares of common stock; **R. W. Gardner,** director, $50 bonus and indirect compensation and 12,090 shares of common stock; **B. Gray,** director, $25 bonus and indirect compensation and 10,000 shares of common stock; **C. E. Norfleet,** director, $50 bonus and indirect compensation and 2,500 shares of common stock.

Kilpatrick, Ballard & Beasley, legal services, $19,164; **Liller, Neal Battle,** advertising services, $183,873.

TRANS TEXAS AIRWAYS INC.—**R. E. McKaughan,** president and director, $26,600 salary, $4,385 expenses paid by company and 28,500 shares of common stock; **H. E. Erdmann,** vice president—operations and director, $14,000 salary, $956 expenses paid by company and 4,765 shares of common stock; **L. J. Erchner,** vice president—traffic and sales, $14,000 salary, $1,839 expenses paid by company and 470 shares of common stock; **M. L. Muse,** secretary-treasurer, $11,800 salary, $655 expenses paid by company and 75 shares of common stock; **W. C. Leatherwood,** director of purchasing and director, $8,800 salary, $193 expenses paid by company and 140 shares of common stock; **J. M. Brooks,** director, no salary or expenses with 220 shares of common stock; **J. K. Ayer,** executive assistant to president and director, $8,800 salary, $2,929 expenses paid by company and 65 shares.

L. A. Downes, chief pilot, $12,300 salary, $338 expenses paid by company and no stock; **Clark, Coon, Holt & Reid,** legal services, $17,648; **Conference of Local Airlines,** $6,902; **Tracey, Locke & Co.,** advertising, $127,713; **Air Transport Assn.,** $6,480; **Sewall Meyer,** legal services, $7,000.

WEST COAST AIRLINES INC.—**N. Bez,** president, $17,333 salary, $3,658 expenses paid by company and 49,195½ shares of common stock; **E. B. Code,** vice president, $12,600 salary, $1,408 expenses paid by company and 250 shares of common stock; **L. J. Hawkinson,** secretary-treasurer, $11,000 salary, $277, expenses paid by company and 10 shares of common stock; **K. N. Lauria,** assistant treasurer, $7,340 salary, $877 expenses paid by company and no stock; **T. B. Crosen,** vice president, $10,200 salary, $2,393 expenses paid by company and 110 shares of common stock; **W. C. Foot,** vice president, no salary or expenses with 2,700 shares of common stock; **J. W. Johnston,** assistant secretary, no salary, expenses or stock.

The following persons were not paid salary or expenses: **D. K. McDonald,** director, no stock; **C. E. Gunderson,** 4,787 shares of common stock; **E. R. Bishop,** no stock; **G. Dunn,** director, no stock; **D. Hogue,** director, no stock; **T. E. Robinson,** director, 2,000 shares of common stock; **D. G. Graham,** director, 1,400 shares.

G. H. Beasley, vice president, $16,375 salary, $5,005 expenses paid by company and 340 shares of common stock; **R. A. Duwe,** secretary-treasurer (expired 1/1/57), $3,462 salary, $31 expenses paid by company, 625 shares of common stock and $1,600 bonus and indirect compensation; **International Business Machines,** accounting machine rentals, $13,745; **Assn. of Local and Territorial Airlines,** $6,000; **Graham, Greene, Howe & Dunn,** legal services, $6,793; **Henry Beecken & Associates,** route extension case, $16,109; **C. E. Leasure,** legal services, $17,935; **Peat, Marwick, Mitchell & Co.,** audit and tax preparation, $17,250.

Radar's Spell

Since the close of World War II the public has been fed a steady tranquilizing diet of the infallibility of radar. On land, on the sea and in the air, the silhouette of the rotating antenna has become the accepted symbol of security, the millenium of technical achievement and the end of perfection. By now it is almost sacrilegious to utter a syllable in contradiction of this dogma.

There is no disputing the fact that radar is a useful tool and one which we would rather not be without. The last time out, however, this column pointed out some actual instances in which radar failed to live up to its billing. It seems the time has come to hold up the finger of caution and to argue for the dispersal of some of our eggs.

Perhaps more than in any other field aviation has made full use of the "magic eye." It has been pushed as an anti-collision device, as a landing aid and as an indispensible part of our traffic control system. All this is good, provided we do not push toward the complete exclusion of other tools. Let us look at what has happened in the realm of traffic control.

Strip Posting Replacement

Radar has made mighty inroads as a replacement for strip posting—the old standard wherein flight progress reports are written on paper strips with crayon. Thus the visual picture presented to controllers enables them to gather more aircraft in terminal areas than with the old method.

It is well known that the strip method of control occasionally broke down. Communications, over-saturation of airspace, intermittent bad weather and many other factors could cause a breakdown. This was not a happy situation.

Now we have radar. So we can get even more aircraft into the same space. And now when we have a breakdown—you guessed it—the mess is even messier. True, the radar system is not supposed to fail—but this is part of the myth. It does fail. Why? Communications, intermittent bad weather, power failure, etc.

Each year has brought with it some new technique which was supposed to be a "vast improvement" over previous radar units—much like the ads for the yearly crop of automobiles. We have had horizontal plotting scopes, remote scopes, long range radar, stand-by equipment, improved polarization and many other items. No question about it either, these things have been welcome additions. But still we have breakdowns, usually when they are least appreciated—as in heavy precipitation. This is not only irritating but dangerous since the standard Army-Navy Civil Aeronautics (ANC) time/distance separations, plus strip posting, don't have a chance of handling the "radar mob."

Gigantic Spider Web

It is more than a little disconcerting to arrive in a terminal and find that the "no delay expected" has suddenly become an hour or more. Normal fuel reserves simply don't take care of such situations. Land elsewhere? Ah, but that's the catch. The terminal area is like a gigantic spider web; once you get in you can't get out—at least not in time.

What I'm getting at here is that there is more to the traffic situation than putting in new improved radar. There must be an independent backup system. There must be data links to speed communications. And better air-to-ground communications. And proper visual aids. A complete system, from ramp to ramp.

Sound familiar? Right. It is. This system concept has been advanced by all the important traffic control committees of by-gone years. Have we lost sight of this? Maybe not, but there is very little evidence of it along the airways.

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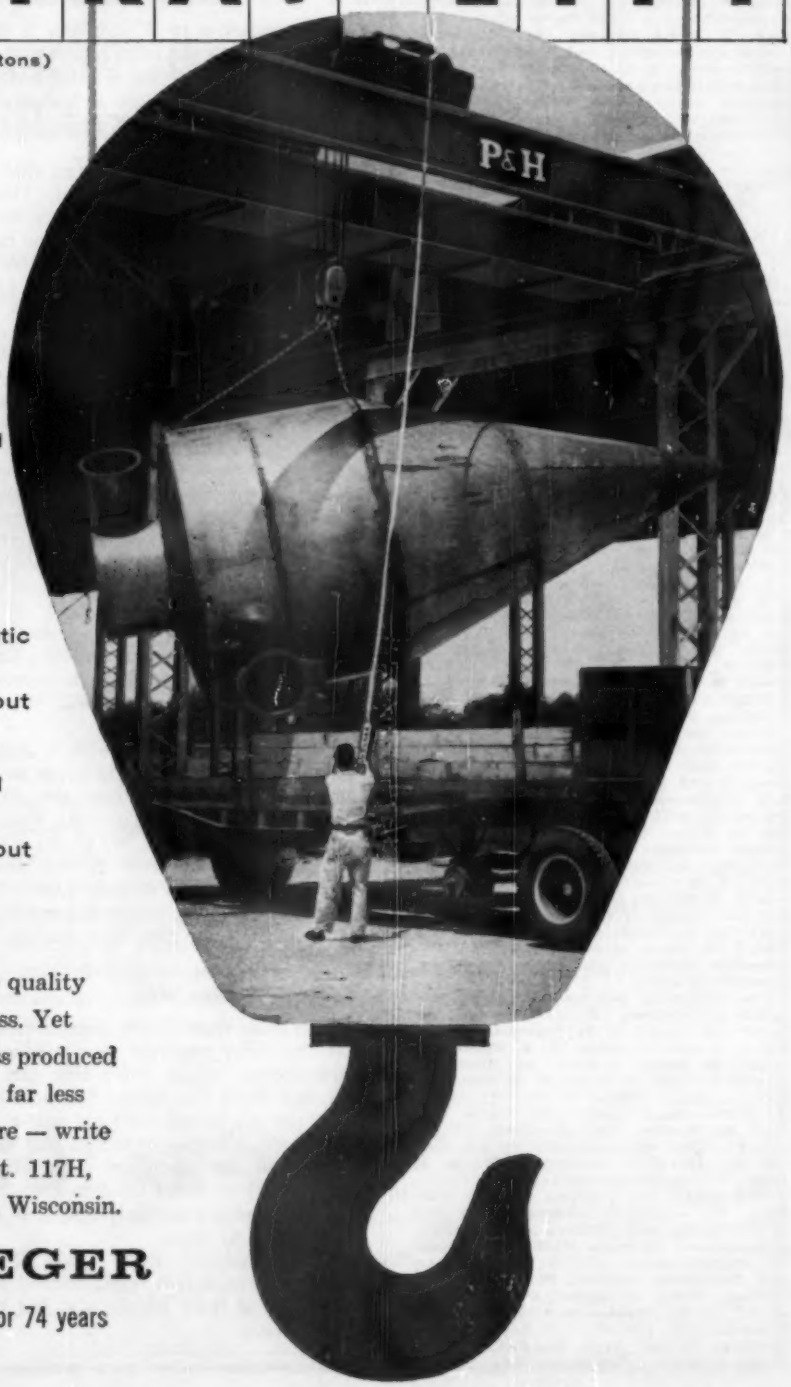

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SHORTLINES

▶ **Australian Cabinet** plans to support the purchase of Vickers Viscount 810 turboprop transports by Ansett Airways and Trans-Australia Airlines. The decision was reached after a detailed technical and financial survey of the airline situation in Australia. Survey showed that more than 70% of the traffic of the Australian carriers is shorthaul operations of under 500 mi. Ansett is expected to protest the decision.

▶ **British West Indian Airways** will inaugurate air freight service in the eastern Caribbean area using Douglas DC-3s on May 1. The British airline, which connects with other airlines at Miami, Bermuda and San Juan, will use Trinidad, Barbados, St. Lucia, Antigua, St. Kitts and San Juan as major cargo points.

▶ **Canadian Pacific Airlines** reports a net loss of $113,000 for 1957. The airline showed a 29% decline in revenue from domestic service owing to cessation of charter services to northern radar installations and the termination of scheduled services to the provinces of Manitoba and Saskatchewan. However, revenue from international traffic increased by 28% as a result of the extensions of the Mexico City-Toronto route to Montreal, Lisbon and Madrid, and the addition of Santiago as a traffic stop on the Lima-Buenos Aires route and an increase in the frequency of other flights.

▶ **Chicago Helicopter Airways** will begin new passenger service between Chicago's Midway Airport and Gary, Ind., on May 1, using Sikorsky S-58s on the scheduled 16 min. trip.

▶ **Flying Tiger Line** reports new company records for air freight traffic during the first quarter of 1958. The airline lists a total revenue figure of $2,479,033 for the first half of 1958 as compared with $2,404,766 for the first quarter of 1957. The March air freight revenue figures was $940,279, against $821,832 for March 1957.

▶ **Japan Air Lines** will extend its international service to Singapore on May 8. The Japanese airline will use Douglas DC-6B aircraft, operating on a Thursday, Saturday and Monday schedule. All flights will stop at Hong Kong and Bangkok.

▶ **National Airlines** was scheduled to begin DC-7B tourist-first class flights last week from New York to Havana, Cuba, and many of the Florida cities served by National.

AIRLINE OBSERVER

▶ Watch for an early order by Northwest Airlines for a fleet of Lockheed Electra turboprop and Douglas DC-8 turbojet transports for its entry into the jet transport competition. Best estimates are that the carrier will place an initial order for 10 Lockheed Electras and five DC-8s within the next month.

▶ **Scheduled flight demonstration of Aerojet-General's infrared proximity warning indicator before airline, military and government representatives was called off because of "bugs" in system which company engineers believe can be cured. Infrared PWI performance has met Aerojet-General expectations in many flight tests, according to reports. Airlines have agreed to cooperate with company to obtain data on strength and pattern of infrared radiation from each type of airliner now in use.**

▶ Pilots' strike against Western Air Lines moved into its ninth week last week. To meet first quarter costs, the airline has sold one DC-6B to Braniff Airways and three DC-3s to a Los Angeles organization. Payroll has been cut to about 400 persons, mostly administrative personnel. In addition to the 263 pilots out on strike, approximately 2,000 employes have been furloughed. Western last week said it will probably be necessary to sell more airplanes to meet current costs if the strike continues.

▶ **Braniff Airways has retired its two Lockheed Constellations 049s from scheduled service but has been unable to find a market for them. Earlier this month, the carrier placed a DC-6B it purchased from Western Air Lines into first-class domestic service.**

▶ Stocks of trunkline carriers listed on the New York Stock Exchange have been reacting differently to a market that has recently shown substantial gains on expanded volume. Braniff and Northwest prices held close to 1958 highs earlier last week while National and Eastern issues hovered near the year's lows. Western showed strength despite the pilot strike. Other trunkline stocks are staying within two to three points of 1958 highs.

▶ **Aeroflot plans to demonstrate the operational versatility of its Il-18 Moskva turboprop transport by using it on contrasting short and long-haul routes soon after it is introduced into scheduled service. The plane, which has a 3,105 mi. maximum range, will be placed on the 395-mi. Moscow-Leningrad run—Russia's busiest—"in the near future." During test flights, the Moskva covered the route in 70 min. The Il-18 will also be assigned to the 5,000 mi. Moscow-Vladivostok route which it will fly with only one stop.**

▶ William Kloepfer, Jr., chief of the Civil Aeronautics Board's Office of Congressional Liaison and Public Information, is on "loan" to the Civil Rights Commission at the latter's request. Kloepfer has been asked to establish an organization for the commission similar to the office he directs for CAB. Period of assignment is "indefinite."

▶ **Subscribers to the Universal Air Travel Plan totaled 820,375 in 1957, a 30,000 increase over 1956. Largest holders of the credit cards were residents of North America with a total of 567,470. Greatest gain last year was in the international section with an increase of 14,000 subscribers bringing the total in this classification to 255,648.**

▶ Civil Aeronautics Board special report to Congress on current airspace problems and CAB safety regulatory activities will be distributed to Senate and House Committees on Interstate and Foreign Commerce this week. The report will cover a detailed analyses of air traffic control including jet scramble corridors, flight test areas and off-airways high altitude routes.

▶ **Continental Air Lines and American Airlines flights flying Victor 8 airways near Las Vegas at 21,000 and 20,000 ft. respectively reported six F-100s maneuvered between the two planes on a threatened collision course Monday, approximately eight hours after the mid-air collision between a United DC-7 and F-100F.**

op′ por·tu′ ni·ty

KEY OPENINGS IN 4 ADVANCED ENGINEERING AREAS AT VOUGHT

ADVANCED WEAPONS

This Vought division is planning, analyzing and proposing new concepts in missile and fighter weapon systems. Here, tactical requirements are established for new weapons, feasibility studies conducted, and proposals prepared.

Select openings exist in both the Advanced Missile Technical Group and the Advanced Aircraft Technical Group. These are responsible positions for engineering specialists and for design engineers up through lead level. Following are requirements for 5 openings which are typical of others in these groups:

Electro-mechanical Systems Analyst. A.E., E.E., or M.E. (advanced degree preferred) with 8 to 10 years experience in analytical design of guidance controls, flight mechanics, dynamics, or comparative applications of applied math. To study advanced weapon systems for guidance, controls, autopilots.

Radar System Engineer or Specialist. A.E., or E.E. (M.S. preferred) with at least 7 years experience in systems and/or design for radar and fire control. To make high-level studies of advanced guidance and control systems.

Advanced Weapons Staff Engineer. Ph. D. preferred, with at least 10 years background in guidance or navigation and control systems. To develop completely new concepts in guidance, navigation, or control systems.

Electro-mechanical Systems Engineer or Specialist. A.E., E.E., or M.E. (advanced degree preferred) with at least 7 years experience in autopilot, flight control, stability systems and inertial guidance systems and design work. To make high-level technical studies of various control and stabilization systems for advanced weapons.

Advanced Weapons Engineer. A.E., E.E., or M.E. (M.S. desirable) able to develop methods for dynamic stability and stabilization studies. To join in, or direct, studies in stabilization, dynamic stability, missile and airframe configurations, and to make flight path and trajectory analyses. All in supersonic and hypersonic range.

AERODYNAMICS

Some of Vought's most vital and interesting problems are in general aerodynamics and automatic flight controls for supersonic and hypersonic weapons. This work involves trajectory and configuration analyses, autopilot studies, control system synthesis and other responsible investigations. Helpful in a number of areas are Vought's low- and high-speed wind tunnels with a speed range from Mach .05 to 5.0.

A limited number of additional specialists may find assignments to match their skills in Vought's aerodynamics activities. These men may have general aerodynamics experience, or a good background in automatic flight control systems. Illustrative of openings available are these 2 posts:

Autopilot Engineer. A.E., E.E., or M.E. (M.S. desirable) plus at least 3 years experience in stabilization, or autopilot and servomechanism analysis and design. To assist in, or direct, autopilot studies and designs for supersonic airplanes and missiles.

Aerodynamics Engineer. Aerodynamics Engineer with A.E., or equivalent, and at least 3 years experience. To work on supersonic aircraft and missiles in aerodynamic analyses of performance, air loads, stability and control, or fluid mechanics.

STRUCTURES

Structures work at Vought is an interesting combination of research, analysis, design and test—a mixture of practical and theoretical problems. Model tests in wind tunnel and on rocket sleds, together with high-speed digital computation, are used extensively for stress, flutter analysis, and dynamic response calculations.

At lead and staff levels in this activity, a few positions of responsibility are open. Especially attractive to men with solid backgrounds in applied mechanics or mathematics, or to men with wide knowledge of structural aircraft elements, are these 3 immediate openings:

Engineering Specialist. Requires Ph. D. To conduct R & D in structural and dynamic loads determinations, or to apply advanced mechanics theories to the solution of structural design problems where high temperatures are a prime factor.

Solid State Physicist. Ph. D. preferred, with at least 5 years experience. To assist in studies of: corrosion control; nuclear radiation damage; parts or systems failures for which no causes are apparent; basic phenomena of solids leading to new concepts.

Lead Structures Test Engineer. Engineer (M.S. preferred) with 5 years experience in structures or related field covering power controls, hydraulics or hydraulic systems, and control systems. To direct groups of engineers in work on structural aircraft elements, components and complete aircraft, including test work and report writing.

PROPULSION

Vought is studying a number of advanced propulsion systems. They include nuclear, solid and liquid fueled rocket components. They involve intensive investigations into internal aerodynamics, heat transfer and other problems.

Additional skilled theoreticians and engineers are needed to advance these studies. For a few men whose skills have been highly developed — academically, or on the job — these openings offer pioneering experiences with an outstanding weapon systems management team. Requirements follow for 4 of these posts:

Aero or Thermo Specialist. A.E., or M.E. with advanced degree plus at least 7 years in propulsion system design, specializing in internal aerodynamics and heat transfer. Special consideration for Mach 4 and above flow study experience. To lead complete studies in this specialty as applied to new propulsion systems.

Lead Propulsion Engineer. A.E., or M.E. with advanced degree, plus 1 to 4 years experience in nuclear, solid and liquid rocket, or ramjet design. To develop new propulsion systems using nuclear and/or rocket fuel components (solid and liquid). To carry design through preliminary stages and possibly assist project phases.

Staff Engineer, Nuclear Propulsion. A.E., M.E., or Physicist with M.S., plus 10 years experience in propulsion system design, including 5 in nuclear development. Should be equipped to perform all technical design work in connection with nuclear propulsion systems.

Propellant Analyst. Chem. E. with M.S. (preferred) or B.S., plus 5 years experience in solid and/or liquid fuel studies. To develop propellants for unique power systems.

To arrange for a personal interview, or for a prompt report on these or other current openings, return coupon to:

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Most missiles land head-first – and, like a bomb, just once. This destruction is desired in a missile strike, but it makes development costly. Scores of missiles often are expended before development problems are solved.

Vought's *Regulus I* and *II* reduce this expense by their dual application. Tactical versions of these guided missiles can strike head-on, with a devastating nuclear wallop. Test and training versions, used in development, can be recovered to fly again.

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Regulus I has armed submarines, cruisers and carriers with a nuclear punch since 1955. *Regulus II*, with a range of more than 1,000 miles and able to exceed twice the speed of sound, soon will join the Navy's underwater and surface Nuclear Fleet.

Scientists and engineers: pioneer with Vought in new missile, manned aircraft, and electronics programs. For details on select openings write to: C. A. Besio, Supervisor, Engineering Personnel, Dept. M-6.

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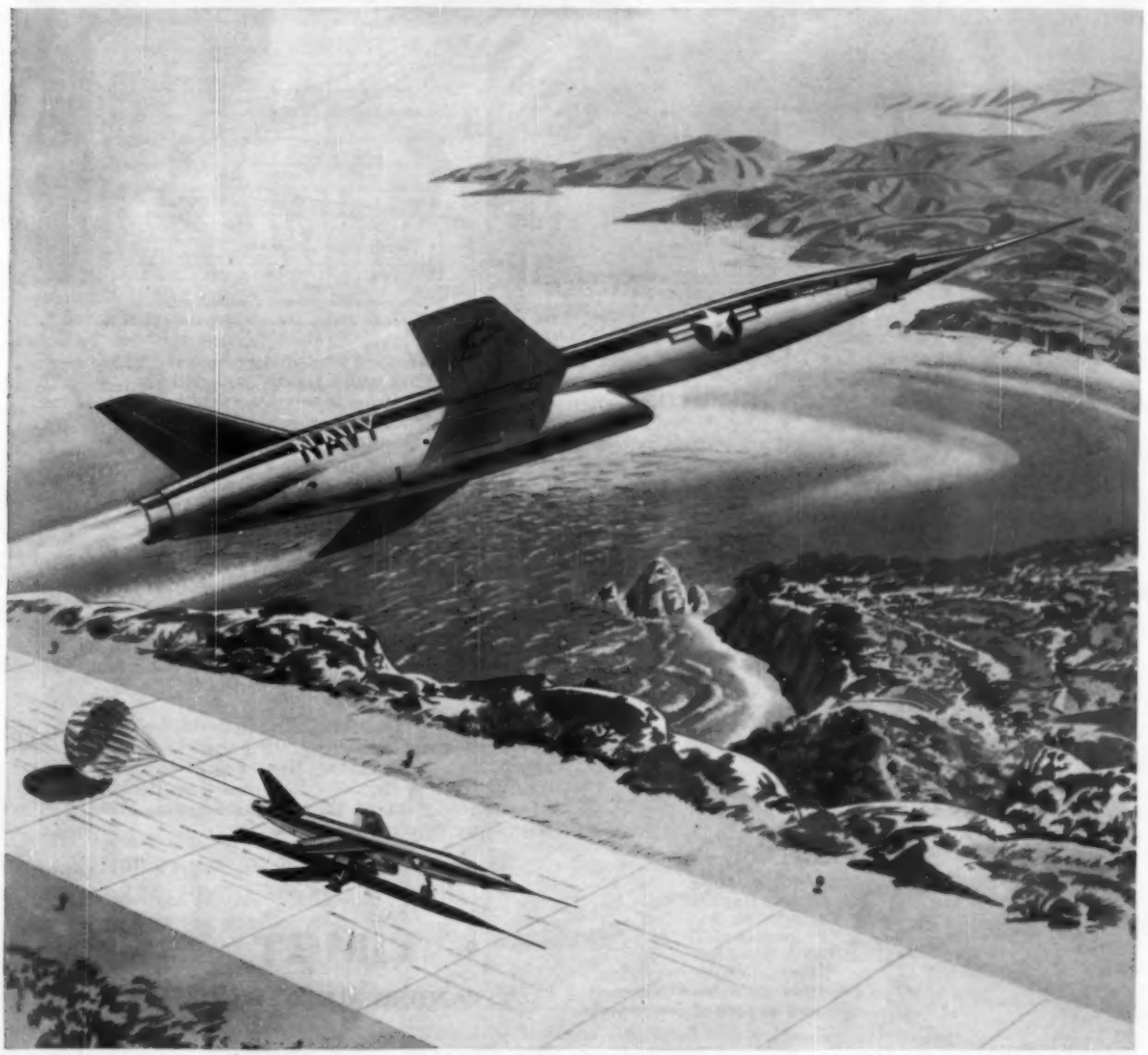

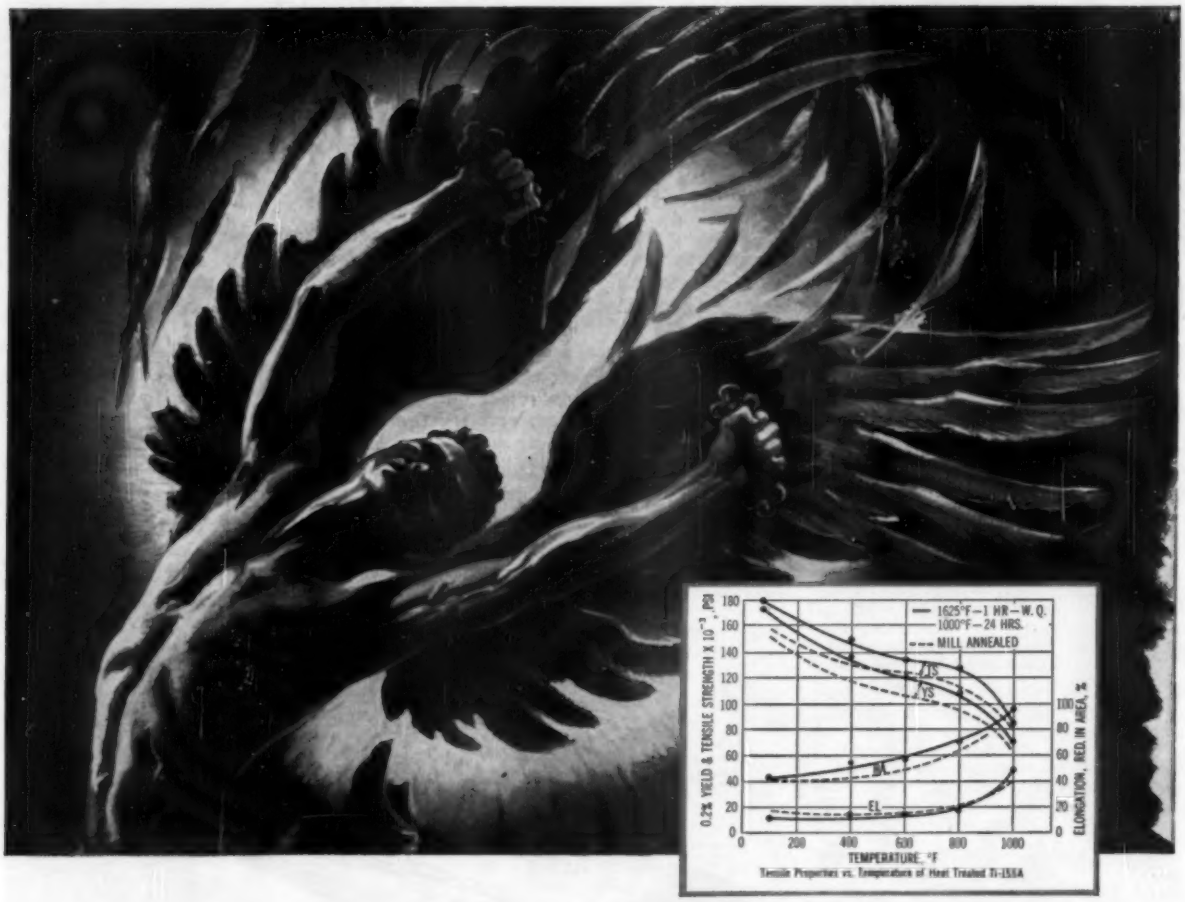

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Pilot Outlines Orbital Test Program

By Richard Sweeney

Vancouver, B. C.—Four-phase program for flight testing an operational vehicle system proposed to place a manned aircraft in orbit was detailed here in a paper by A. W. Blackburn, engineering test pilot for North American Aviation, Inc.

Presented at the semi-annual meeting of the Canadian Aeronautical Institute, the paper outlined a hypothetical vehicle system, with design and performance parameters taken from Dr. Wernher von Braun's Mars project and scaled down.

Blackburn's vehicle had an initial stage with approximately 3 million lb. thrust and weight of 1½ million lb. Second stage thrust approximated 350,000 lb. with a gross weight of about 200,000 lbs.

Third stage orbital vehicle would weigh 13,000 lb. at burnout, should enter a circular orbit 935 naut. mi. about earth's surface.

Third Stage Launch

This third stage would be designed as a complete aircraft, capable of being carried up and launched from a mother ship like X-1, X-2, and X-15. Phase I of the test program would be a thorough investigation of performance envelope of this vehicle, with work including glide flights to check low speed and landing characteristics, powered flights to ascertain supersonic and hypersonic flight qualities, plus starting to define the re-entry problem for this particular vehicle.

Areas requiring close attention in this phase would include controls, three-axis damping system, and heating problems, with a full measurement of heat inputs, and other aspects in level flights and through the steeper trajectories.

Phase II would have second and third stages operating together. Second stage would not be manned, but would have provisions for recovery after flight. Presently envisioned as using liquid propellant rocket engine, this stage could use a solid propellant rocket, with attendant gains in simplicity, economy, reliability.

Dummy Units

Before manned flights are made, second stage would be checked out with dummy units simulating third stage mass, geometry, drag, and sufficient launches made to provide second stage stability, control programming and performance.

Initial piloted tests should be at less than maximum burning time for second stage, accenting flexibility of liquid propellant propulsion for this stage in this part of test program, Blackburn said.

Phase III, conducted concurrently with Phases I and II, would see flight test of the first stage liquid propellant vehicle.

Blackburn suggests that unlike von Braun's first stage, this might be piloted, with obvious gains in economy, mobility, flexibility. Mounting of an auxiliary set of turbojet engines would further enhance this stage by adding considerably to mobility, flexibility and above all, boosting ease of landing and safety for this rather costly and large stage.

Initial flights would be at less than maximum gross weight, at reduced power, attaining perhaps 40,000 ft. altitude at burnout. These tests would prove control systems, low speed and landing characteristics.

Expecting that this first stage would coast to altitude on the order of 300,000 ft. in launches, Blackburn would have this vehicle work toward this altitude slowly and alone to investigate its individual re-entry conditions, other parameters.

Again using dummy shapes to simulate mass, drag of second and third stages, first stage would demonstrate its ability to accelerate its payload to required altitude, attitude and velocity. Horizontal travel of this stage would be 180 mi.

Phase IV would see man and vehicle lifted into orbit. A gradual approach would naturally be used, during which navigation, ground monitor systems would be thoroughly checked in operational conditions, and final data on various re-entry situations would be obtained.

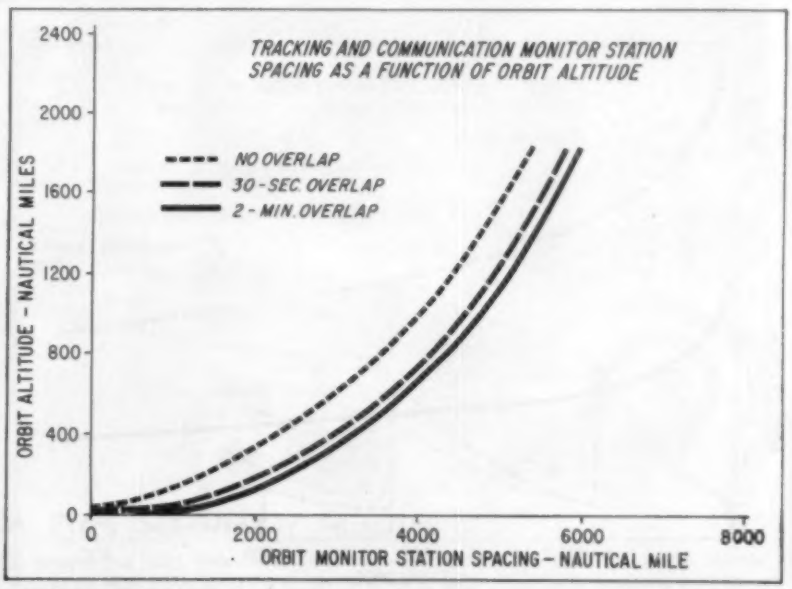
Elliptical Trajectory

First orbital effort would see third stage at burnout—53 naut. mi.—with sufficient velocity at this point to coast to an apogee of 935 naut. mi. Relighting rocket engine to add velocity increment of 1,500 fps. would enable establishment of circular orbit at this distance.

However, preferable first flight technique probably would be to allow elliptical trajectory to continue since on approaching perigee of 53 naut. mi., the re-entry maneuver would be initiated since enough atmosphere for significant deceleration is encountered from 70 naut. mi. downward.

Depending on re-entry technique, vehicle thus would make 1¼ to 2 circuits on first orbital trip.

Advantages of the elliptical orbit technique on first trip are several. There is no requirement for satisfactory relighting of rocket engine; however, if engine is functioning properly, fuel



TWO MINUTE overlap, considered realistic, would require monitor station every 650 mi.

allocated to establishment of circular orbit and upsetting it for re-entry could be used for heading corrections or aborting re-entry should either appear necessary.

During test program, third stage burnout velocity variations and apogee maneuver adjustments can yield many orbit trajectories. Varying orbit geometry according to mission could span from a reconnaissance or mapping circular path at 90 naut. mi., to an elliptical track with apogee at approximately 1,000 naut. mi.

Two factors in orbit selection would be landing bases and monitoring station sites, both with "real estate problems of a global nature," Blackburn noted.

Spacing monitor stations for continuous coverage with station overlap of 30 sec. at a 90 mi. orbit would require a station every 1,450 mi. More realistic time overlap figure of 2 min. would require stations every 650 mi.

Initial test apogee of 1,000 mi. would increase monitor station spacing to 4,000 mi. on the other side of the world, a more realistic possibility, but "from this high altitude, observation of such tourist attractions as industrial centers, airfields and missile launching pads might be difficult," according to Blackburn.

Role of the pilot in the venture is multiple and essential; his presence is more than justified by weight of equipment he replaces. He will participate in design of all parts from inception.

He will require a pilot display which tells him what he needs to know, trends as well as conditions and failures. He will ensure that he can adequately monitor those automatic devices over which he has some control. As an example, pitch of the first stage is programmed, pilot must be able to monitor and overpower it in case of improper performance by automatic controls.

Pilot Program

Pilot will become an essential part of his machine from inception by use of simulator and analog computers, with actual hardware replacing the analog circuitry as soon as it is fabricated and checked, to ascertain its performance in its particular subsystem, its compatibility with this subsystem's other components and overall compatibility of part, subsystem, system and whole vehicle.

Reference was made to time histories of accelerations involved in two possible orbital vehicles—von Braun's ferry satellite for Mars project, and a theoretical system used by Preston-Thomas in his acceleration studies. Man's tolerance to acceleration, as detailed from available literature by Hegenwald and Oishi, also was considered.

Limit of voluntary tolerance is defined for upper curve, where accelerations produce no worse than short periods of extreme discomfort or unconsciousness. Limit of useful consciousness is the boundary of awareness sufficient for proper response to stimuli which normally produce well indoctrinated reactions.

It is to be remembered here, Blackburn points out, that although the satellite acceleration time histories cross line of useful consciousness, line of force application and fact that true time history of maximum acceleration tolerance is not represented, indicate that pilot will not necessarily be blacked-out. Preston-Thomas experiments indicate that while performance of subjects remained adequate throughout spectrum in high acceleration launch, performance went up very sharply as subjects gained experience in high transverse accelerations.

High point of flight simulation would come with pilot and cockpit flying a mission with complete three-axis accelerations added through mechanization of centrifuge. Making the pilot "at home," i.e. removing the surprise elements, during the launch and raising his experience level in working at these high accelerations, will better enable him to concentrate on control problems and be better able to deal with any emergency which might possibly arise.

Weightlessness

At termination of high G loads, opposite factor comes up—zero G or weightlessness. Short time histories of this have been ascertained through USAF flight test programs, but significant data on long term weightlessness is lacking, will be until space flight arrives. However, Blackburn urges two steps which should materially reduce discomfort:

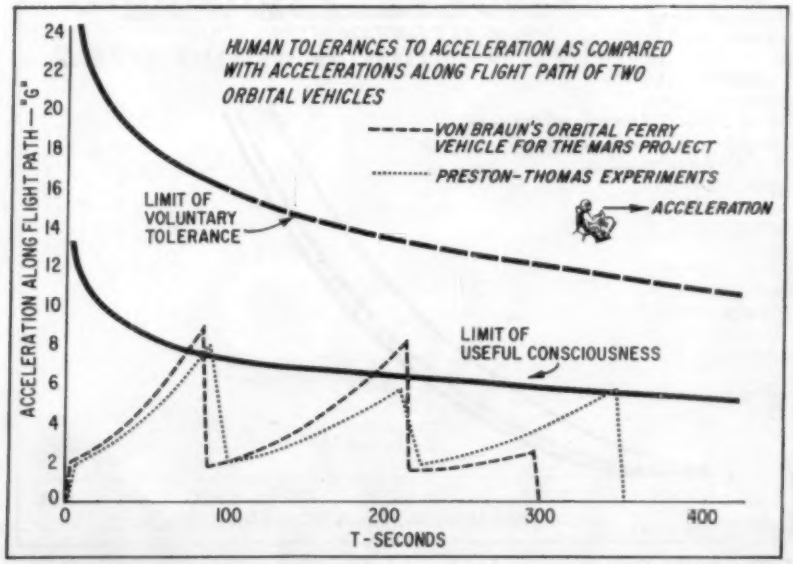
- **Provide pilot** with snug but flexible physical restraint.
- **Keep pilot** constantly occupied.

Temperatures involved in reentry are, for the vehicle and the pilot as well, of "roasting magnitude." Analysis has determined maximum times a "well motivated" man can effectively perform at various heat levels with two types of protective clothing, the heat curves being conservative estimates made from actual tests by Vince Blockley. Definition of "well motivated man" is not clear, Blackburn says, but "it is difficult to imagine a stronger motivation that preserving one's self from imminent incineration."

Blackburn compares tolerances between men and electronics gear in heat environment, and cites fact that heat dissipation from avionics equipment may be a problem. He notes heat generation comparison between man and machine, with man producing about .8 watts per lb. of weight, while autopilots put out some three to four watts per lb.

Psychologists, Blackburn says, have predicted that space travel will be dull to the point of boredom, which could lead to hallucinations, sound sleep, self-destructive tendencies.

Cosmic radiation's complete nature outside the atmosphere is unknown, though indications from Explorer I satellite are that this is not sufficiently concentrated to be dangerous to man. Additionally, Phase I and II of this program would help gain more data in this area.



UPPER curve defines voluntary tolerance limits, which produce short periods of discomfort.

Scientist Warns of Space Effort Pitfalls

Downey, Calif—Hard-headed appraisal of problems that lie ahead for space technology, and a warning against over-committing the nation's efforts in this direction at the expense of more immediate defense needs, has been made by Dr. R. E. Roberson, chief scientist, advanced engineering, North American Aviation, Inc., Autonetics Division.

"Anybody who talks casually about the development of astronautical systems as if there were no real problems to be solved, only engineering details to be worked out, is careless with the truth," Dr. Roberson said in a talk to North American's Management Club. "We are still in a profound state of ignorance in many areas which may appear relatively elementary."

For example, problem of keeping a satellite right-side-up in its orbit to permit telescope or television cameras to be trained on earth for reconnaissance purposes has been dismissed casually by some as a mere detail, Dr. Roberson said, "but as one who has worked on the problem for six years, I assure you it's no detail."

Probing Needed

Initial space probing, that will use satellites, lunar and planetary vehicles and rudimentary manned vehicles, must be accomplished quickly because further development will be hampered until such knowledge is gained, Dr. Roberson contended. "One of our deepest areas of ignorance concerns the space environment as it affects both equipment and humans. Finding its characteristics is our first priority job.

"Because this problem is a bottleneck to progress, it is more important to get it done than to do it in the cheapest and most efficient way," he said. "This means the use of existing ballistic missile vehicles, with the addition of one or more extra stages. This should permit manned lunar circumnavigation, perhaps even lunar landings," he added.

"Immediate goals of experimentation and exploration can be accomplished by existing hardware accompanied by some relatively straight-forward engineering development," Dr. Roberson said.

"Our later goals can be classified as exploitation—for military advantage—of resources of other planets for benefit of Earth, or development of these resources by interplanetary colonization.

"Operations of this kind are huge. They will involve unprecedented cost. And there is a tremendous payoff in going to efficient systems as opposed to those that will barely do the job," Roberson declared.

Payload on Mars

With longer range missions, and larger payloads, problems become more acute. To put a one-pound payload on Mars will require a vehicle whose gross weight is 12 times that needed to put the same payload into a low satellite orbit.

On the basis of a Vanguard-type vehicle, gross weight would be 12,000 lb. for each pound delivered to Mars.

Dr. Roberson said it may be possible to put a small payload on Mars using combinations of existing components, but the payload "may not be a very useful one. We would be better advised to treat this as an advanced mission requiring the development of new systems."

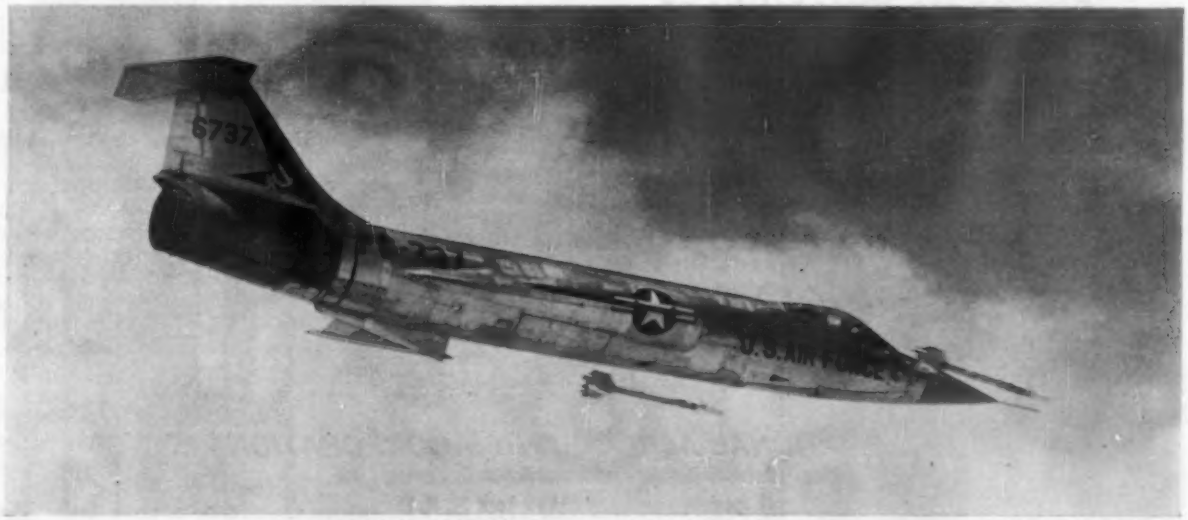
To produce required propulsion, Dr. Roberson believes that development will continue both in the direction of larger rocket engines and in new types of power plants, such as ion propulsion where specific impulse may be "more than 50 times that of the best present chemical fuels."

Space Environment

Another major problem area cited by Dr. Roberson is providing an environment in which man can live and work with acceptable efficiency. Before this can be done, more must be learned about the environment and what is required, i.e., will it be necessary to induce artificial gravity for a space traveler in order that his body's physiological processes will continue to function properly.

Stresses imposed on humans by isolation, when there is no way to return until the proper time and no panic button to open the door, have yet to be determined, Dr. Roberson pointed out. He suggested that the only way to approach this simulation on earth may be "in a small one or two-man submarine resting on the bottom of the ocean."

Dr. Roberson admitted that after six months of investigating the problem of how to guide a space vehicle into position where it could be captured by Mar's gravitation field, "we still don't



F-104A Fires Sidewinder Missiles

Air Force Lockheed F-104A Starfighter interceptor releases two Navy Sidewinder infrared-guided air-to-air missiles. Sidewinder missiles have been fired from at least 10 different types of aircraft by Navy (AW April 14, p. 23). F-104A is most recent to be equipped with them.

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Mere Design Detail

Illustrating the glibness with which some persons shrug off space technology problems as mere engineering details, North American Aviation's Dr. R. E. Roberson told this story:

There once was a grasshopper who hopped and played all summer without a care in the world until winter approached and he realized he had no food supply. He went to his friend, the ant, who had worked busily all summer laying in food and asked the ant for expert advice on how he could get through the winter.

The ant took the problem under consideration and in a few days returned with a complete report, handsomely bound and profusely illustrated. "The solution is really very simple," the ant said. "You merely turn yourself into a cockroach and live in someone's kitchen all winter."

The grasshopper was delighted with this advice, but said: "I'm bothered about only one point. How do I turn myself into a cockroach?" The ant replied: "I have given you a complete concept. Turning yourself into a cockroach is an engineering design detail."

know how to point the (vehicle) to get to Mars." Present indications are that the vehicle might be aimed toward the sun, and away from Mars, in order to end up on that planet.

This is what Dr. Roberson terms a "concept problem" because he believes that an ingenious concept is needed to simplify required guidance equipment.

Extremely accurate inertial guidance components developed for ballistic missiles probably will be adequate for space navigation, particularly if some sort of terminal guidance is employed, according to Dr. Roberson.

Space Reliability

Critical problem for avionics equipment is to achieve reliability required for duration of long missions involved in space travel. For example, a one-way trip to Mars in an ion-propelled rocket might require 6,000 hr. If the probability of avionic equipment failure is to be held to 1%, the mean-time-to-failure of the equipment must be 600,000 hr., or about 68 yr., he pointed out.

This is the equivalent of putting 100 systems in a vault, supplying them with electrical power, opening the vault roughly 70 yr. later and finding that 37 of the 100 systems are still in perfect operating conditions.

Achievement of this sort of reliability will require an improvement factor of between 100 and 10,000 over that obtainable with present day avionic systems, Dr. Roberson said.

Another difficult problem area is developing a suitable source of electric power for long missions. Most feasible methods, according to Dr. Roberson, appear to be in use of nuclear reactor or a solar boiler.

Radiation from a space vehicle nuclear reactor will cause trouble for photosensitive elements used in star trackers or TV cameras, and for glass lenses or prisms used in optical systems, the scientist noted. Radiation also would adversely affect transistors and diodes used in digital computers and systems employed for navigation and control.

Solar boiler avoids the radiation problem, but requires added controls to position collector mirror toward the sun and batteries to provide power during periods when sun is not visible.

Operating temperature may be a problem with both nuclear and solar power systems. Thermal conversion efficiencies are relatively low, hence considerable energy must be dissipated in the form of heat by radiation from the vehicle. If vehicle reaches a fairly high equilibrium temperature, or develops local hot spots, the guidance and control equipment may have to be artificially cooled, adding further weight and complexity.

While emphasizing the international implications and propaganda impact of astronautical achievements, Dr. Roberson cautioned against embarking "on a rash of ill-advised projects.

"I would hate to see us commit too large a percentage of our research and development funds, and manpower, to the astronautics area and forget that there are still important unsolved problems in other areas—and this now appears to be a genuine danger," he warned.

Crystal Space Gazing

Timetable of space exploration, based on predictions by number of sources, has been prepared by Dr. R. E. Roberson, chief scientist, advanced engineering, North American Aviation Inc., Autonetics division:

1959-1960: Unmanned lunar probe.

1960-1961: Unmanned lunar circumnavigation and return.

1960-1962: Elaborate earth satellites with more sophisticated instrumentation.

1961-1962: Man in satellite orbit and recovered.

1961-1964: Controlled lunar landing with significant instrument payload.

1962-1965: Manned circumlunar flight.

1963-1966: Instrument payload landed on Mars or Venus.

1964-1968: Man landed on Moon and returned.

1968-1973: Man landed on Mars and returned.

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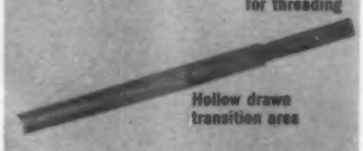

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HOW CAN AN ANTI-MISSILE MISSILE TELL A DECOY FROM THE REAL McCOY?

TO CONFUSE anti-missile missiles, an incoming missile may explode its final stage rocket casing as it approaches target. The resulting fragments would surround and travel with the missile, acting as decoys.

This is only *one* of the AMM guidance and arming-fuzing problems.

There is also the fantastic closing speed of the two missiles which allows only seconds to resolve and relay course correction data to the launched AMM. And there are environmental problems of extreme acceleration, vibration, velocity and heat that exceed even those found with ICBMs.

At Honeywell, however, solutions are in sight.

The decoy problem may be solved by detecting a piece of the enemy missile near the center of the fragment cloud and ignoring individual pieces. Or, if the fragment cloud does not exceed the effective explosive radius of the AMM warhead, the AMM fuse can simply act on the entire cloud.

For further information, contact Minneapolis-Honeywell, Military Products Group, 2753 Fourth Avenue, South, Minneapolis 8, Minnesota.

The fuzing system for Sidewinder is now being manufactured by Honeywell in quantity. And Honeywell is also producing systems, sub-systems and components for ASROC, Wagtail, Thor, Titan and many classified missiles. This broad systems experience makes Honeywell the logical company for anti-missile missile development work.

Honeywell

H Military Products Group

Specialists Grouped To Form Space Unit

New York—Allen B. Du Mont Laboratories, Inc., has grouped company space specialists into a new unit called Spacetronics.

The organization will operate under the guidance of a top level, policy-making committee.

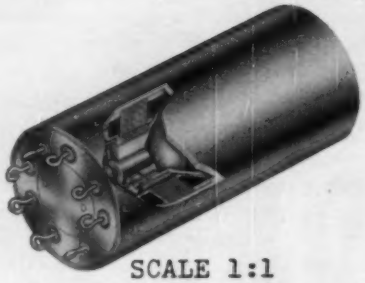
The Spacetronics group will be responsible for planning of guidance and reconnaissance systems, instrumentation, and test equipment related to missiles, satellites, hypersonic aircraft and space vehicles.

The group has already taken over present Du Mont contracts in this area and will handle future contracts as they come in.

Reason behind the creation of spacetronics, according to Du Mont vice-president Fredrick H. Guterman, was the belief that such projects could receive top priority service only through a cohesive team effort.

The previous system of taking experts from programs and assigning them to special missile and space projects as needed, has proved itself incapable of coping with the growing work load in space electronics, he explained.

Reliability **HISTORY** *of the H-3 Gyro*



SCALE 1:1

PICKOFF TEST DATA

Posted to: 18 Feb '58

Engineer: H.L.B.

Purpose of Test:

To establish stability of zero set with time and under conditions of severe temperature cycling.

Procedure:

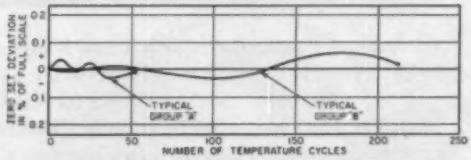
Group A - 5 gyros shock cycled in circulating air chambers from -65°F to +200°F. 2.5 hours per cycle (57 cycles).

Group B - 6 gyros extreme shock cycled by direct metal to metal contact with large thermal sinks at -65°F, + 75°F, and + 200°F. 0.7 hours per cycle (225 cycles).

Zero set measurements taken at room temperature.

Conclusions:

During and after thermal cycling far in excess of any known requirement, gyro zero set remained extremely stable.



TYPICAL GRAPHS OF ZERO SET STABILITY OF PRODUCTION GYROS

Military Products Department

AMERICAN-Standard

DETROIT CONTROLS DIVISION

100 Morse Street, Norwood, Massachusetts

Scientists to Check Atlas Radar Signals

Doppler radar signals emanating from Atlas intercontinental ballistic missiles will be monitored by scientists in an attempt to gather data concerning the density of free electrons in the ionosphere. Free electrons effect on guidance and radio communication requires that more precise information on the subject be gathered before attempting space exploration.

Space Technology Laboratories, a division of Ramo-Wooldridge Corp., will conduct the research experiments for the Air Force. Three portable Doppler radar units at Cape Canaveral, Fla., will pick up the Atlas radar signals.

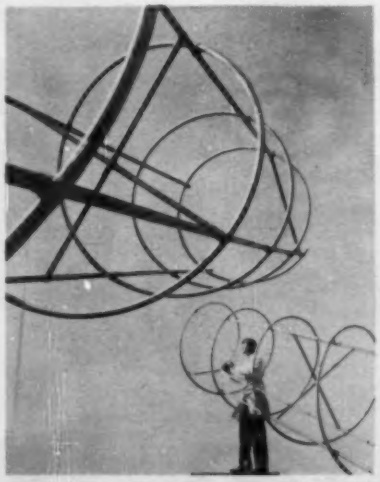
Space Technology scientists claim that the usual method of determining electron density by bouncing low frequency waves off the ionosphere are not accurate enough for space vehicle studies.

It is known that there are at times approximately 50,000 electrons per cubic centimeter at an altitude of 80 mi. and 2,000,000 pcc. at an altitude of 250 mi. Researchers said however, that at ionospheric heights there has been no precise way of measuring free electron density.

New method will be to investigate differences in frequencies recorded by the radar units, based on knowledge of the Atlas' speed and altitude. It is predicted that data gained by this method will be perhaps 10 times more precise than present information.

Atlas missiles will not be required to carry special instrumentation for the electron density experiments.

Prime purpose of the Doppler radar emanations from the Atlas missile is to aid Cape Canaveral scientists in tracking the missile.



CIRCULAR radar antennas will receive Doppler signals from Atlas missile.

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PASSENGER utility tables are a feature of three-abreast seating configuration (left) on Douglas DC-8 jet transport. Plastic oxygen masks pop out of seat backs if cabin depressurizes. At right is main passenger section, with two-abreast seating on starboard side.

Safety Dominates DC-8 Jetliner Design

This is the second of two articles by Russell Hawkes on the Douglas DC-8 jet transport. The first article appeared in last week's AVIATION WEEK.

Santa Monica—Douglas DC-8 jet transport structure and system design is dominated by the "one member out" principle of fail-safe engineering which holds that no single member or component should be essential to safe, economical flight.

Electrical and cabin air systems are intended to have adequate output with two major components or subsystems failed so that the airplane can make a normal passenger carrying flight with safe reserve system capacity even though one subsystem or component is known to have failed before take-off.

Structures are designed to be fatigue-resistant as well as fail-safe, although rules require the use of only one of the two criteria. Huge structure test program out of which the airplane grew was laid out as a progression from tests of single fastenings through tests of increasingly larger specimens composed of many skin panels and structural members. The same philosophy of progressing from small to large specimens governed system testing. Second airplane off the assembly line has entered test rigs to try out the complete airplane under proof loads. Flight testing is expected to begin in the latter half of May.

Thorough study of every system and structure in the light of the "one member out" principle was made possible by late freezing of the basic design. To ensure early testing and quick application of advanced thinking, Douglas has opposed the industry trend to segregate research and development from production engineering and maintain contact between the two through special liasion arrangements. Administering development work and production engineering within the same organizational framework has made bookkeeping operations difficult but Douglas management is convinced that it paid off in the drive to build a newer, more thoroughly engineered jet transport.

To date, approximately $200 million has been spent on the DC-8 program. The basic design firmed up late in 1955. Fabrication of parts began in September, 1956, and assembly began in April, 1957.

Fuselage Structure

DC-8 fuselage is a semi-monocoque structure of stretch-formed skin sheets, rolled, extruded or stretch-formed Z-section transverse frames spaced at 20 in. intervals and rolled or extruded hat section longerons which are attached directly to the frames.

Pressurized section of the fuselage is 12 ft. wide, 13.5 ft. deep and 115 ft. long. It is designed to be pressurized to a cabin altitude of 6,700 ft. when the airplane is flying at 40,000 ft. This amounts to a pressure differential of 8.77 psi. The pressure cabin will be tested at 1.33 times maximum relief pressure or 12.33 psi. Maximum leakage acceptable is 350 cu. ft. per min.

Cabin floor is designed for 9G ultimate crash loads and distributed floor loads of 1,500 lb. for each 40 in. of cabin length. Main load bearing floor structure consists of six-inch deep transverse H-sections in every frame at the cusp of the double-bubble fuselage. Location of the floor at this point allows the transverse members to pick up pressurization loads in tension. Longitudinal floor stiffeners are Fiberglas hat sections. Aluminum intercostals help carry structural loads.

Cargo Compartments

Cargo compartment floors are designed for a maximum load of 120 psf. Maximum capacity of the forward compartment is 6,900 lb. and that of the aft compartment is 7,000 lb. Passenger cabin and cargo compartments all are pressurized. Number of passenger windows in the DC-8 is less than that of competing airplanes because of the weight penalty they create. Window frames are made stronger than surrounding structure because of the tendency of stresses to concentrate around an opening.

To claim a fail-safe structure, a manufacturer is required to demonstrate either that it will survive maximum loads with one member failed or that it is fatigue-resistant. Douglas decided to do both. Engineers consider fail-safe design essential because in a large airplane there are too many unforseeable stress concentrators like scratches and nicks. Fatigue resistance is necessary even if fail-safe design eliminates actual danger because fatigue is an economic cost factor. According to Emerson LaBombard, assistant chief of structural design of the DC-8, fatigue life should be defined as the period of time an airplane can be operated before the cost of repairing fatigue damage makes the airplane uneconomical to fly.

LaBombard credits much of the de-

velopment of the multiple load path or "one member out" philosophy of fail-safe structural design to NACA studies which showed structural integrity to be a function of the ratio of frame weight to skin weight. He said the principle is even more significant when skin is tied tightly to frame as in the DC-8 rather than loosely as in preceding generations of planes but he said precise ratios are made invalid by the variety of materials used.

Douglas engineers have built overstrength into DC-8 as insurance against fatigue. They regard the weight of the overstrength as pre-paid growth factor penalty for future increases in range or payload when flight experience has shown precisely how much overstrength exists.

Ripstopper strap between skin and substructure is of titanium which was found to be the lightest material with the high modulus needed to stop the spread of a failure by limiting skin deflection. No magnesium was used in the airplane because Douglas engineers feel the corrosion problem is still unsolved.

A three-spar wing structure was chosen so that if one spar is damaged, the wing still has a closed torsion box. Only 10% of wing bending loads are carried by the spars. The remainder is carried by the skin and spanwise stiffeners.

Extruded Sections

Spar caps, spar webs and stiffeners are extruded. Y-section stiffeners are used along the upper wing surfaces and I-sections are used along the lower surface.

They are riveted directly to the skin. Integral stiffening for the wing was rejected because of fail-safe design considerations. A fracture in the integral stiffener can spread into the skin. The interface between separate stiffener and skin serves as a boundary past which a rip cannot propagate.

This objection to integral stiffening could be overcome by using small skin sections with the joints between sections acting as rip stoppers, but it would be uneconomical in terms of weight and production costs and would make it difficult to seal the integral fuel tanks. Integral stiffening is used between the front and rear spars on the stabilizer where narrow skin panels are practical because of smaller structure.

Wing skins are roll-tapered and butt-spliced. Adhesive bonding is used for structural attachments in the wing trailing edge near the engines where acoustic frequencies are a problem. Advantage of bonding is absence of rivet holes which are likely starting places for fatigue cracks. Honeycomb is used in few places because repairs are difficult and tend to be heavy. It never is used in balanced control surfaces because the weight of a repair would probably call for a counterweight to maintain the balance of the surface.

Care has been taken in DC-8 to keep lower wing skin splices away from heavy wing bending loads to get acceptable strength for minimum weight. Heaviest load is at the dihedral bend where the wing passes into the fuselage. A splice is avoided here by stretch forming 47 ft. long skin sections to fit the bend. This replaces a splice at each wing root by a single splice beneath the fuselage centerline where loads are relatively low.

Since it is within the fuselage loftline, external as well as internal splice plates can be used. Douglas engineers estimate such a joint to be 10 times as fatigue resistant as internal plate alone. Other joint in the wing was placed as far outboard as possible (408 in. from centerline) to minimize the load upon it. Leading edges of the DC-8 wing, fin and stabilizer are removable to make possible quick replacement of a damaged leading edge. Removal of the wing leading edge also gives access to plumbing and wiring installed along the front face of the forward spars.

Speed, size, altitude and fatigue problem for jet transports makes quality control far more important than it has been in earlier transport generations. Major sources of work for the quality control engineer are fastener hole tolerances, smoothness of edges and surfaces and the taper of skins.

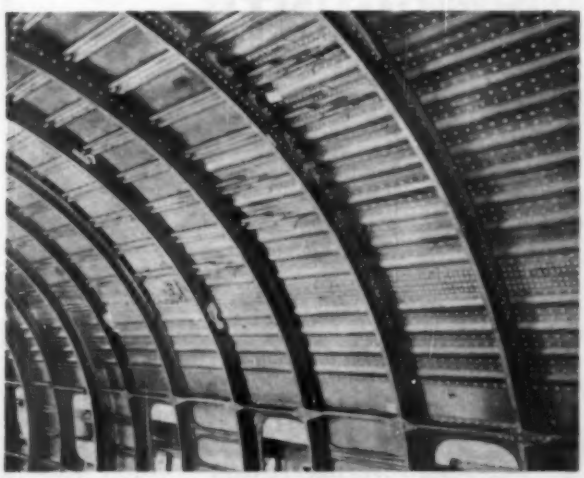
Choice of materials has some bearing on fatigue resistance but it is negligible compared to the effect of a good or bad rivet hole. This fact has led Douglas to undertake a massive study of fasteners and hole preparation. The several thousand fastener holes in the DC-8 are drilled to a tolerance of .0005-in. in diameter. If tolerances are loose, not all of the fasteners will be working while others will be carrying more than the design limit load.

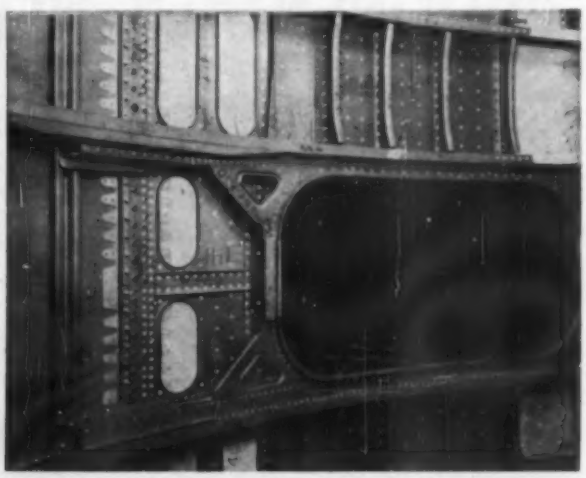
Every important joint is fatigue tested and friction in the attachment is analyzed. High friction levels are desirable since they add static strength to the joint.

Fit Checked

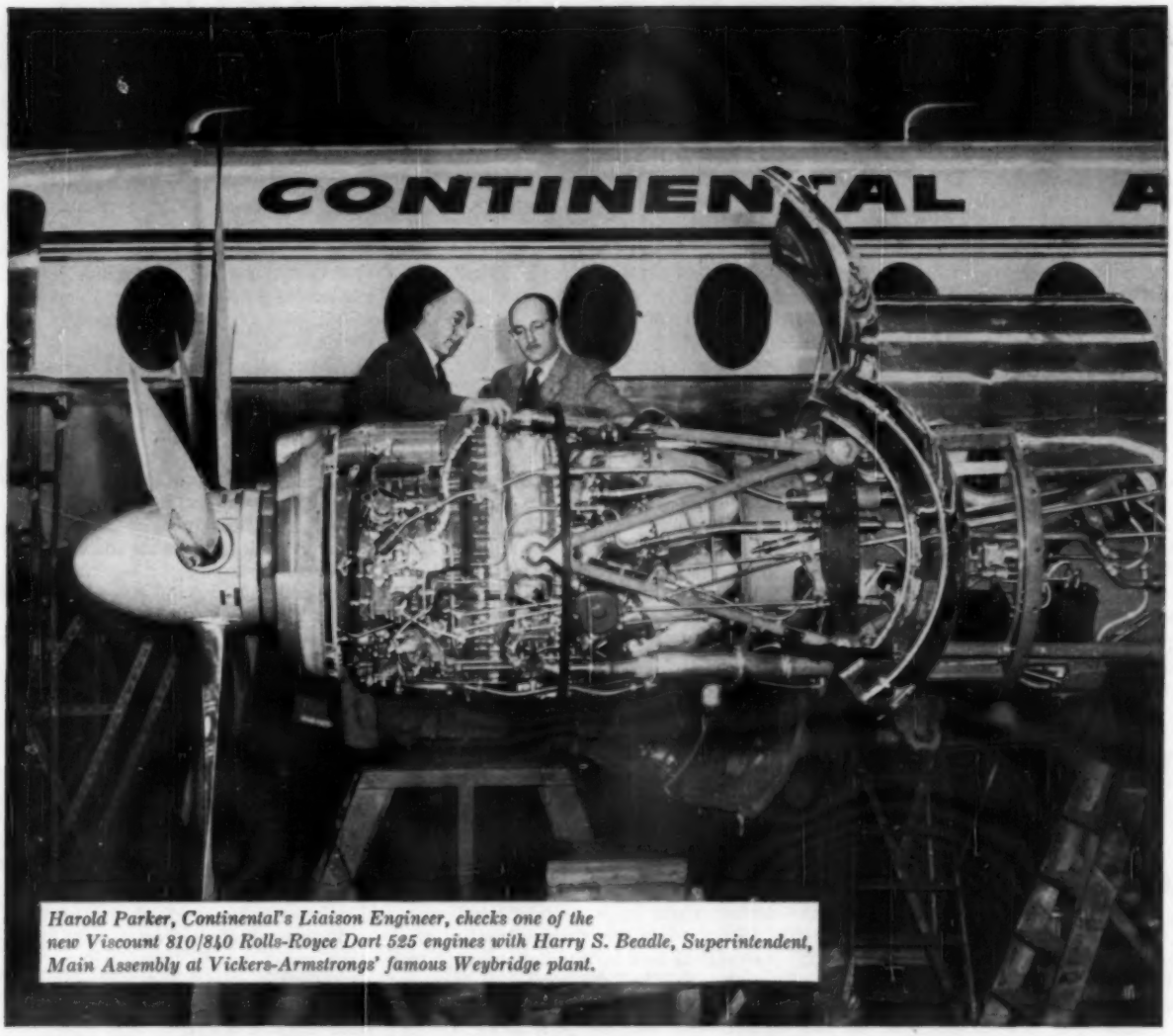
Locked-in stresses due to forcible joining of parts that don't quite fit is a hazard avoided by checking fit at every interface and bolt-hole before the joint is fastened. This pre-loading is more dangerous in big sheets than small ones, so Douglas engineers favor built-up assemblies of small pieces when other considerations are equal.

Huck fasteners are used wherever possible because there is zero tolerance. The hole is smaller than the shank of the fastener, giving an interference fit which is light and tight. A collar swaged onto the end of the shank serves





HAT SECTION longerons (left) are closely spaced; give high ratio of substructure weight to skin weight for fatigue resistance. Scalloped titanium rip stopper (right) is between skin and frame of cabin. Titanium was chosen for high modulus, low weight.



Harold Parker, Continental's Liaison Engineer, checks one of the new Viscount 810/840 Rolls-Royce Dart 525 engines with Harry S. Beadle, Superintendent, Main Assembly at Vickers-Armstrongs' famous Weybridge plant.

MORE POWER ON LESS FUEL FOR CONTINENTAL'S NEW VISCOUNTS

"From an engineer's viewpoint, the most important advance in the new Viscount 810/840 is the new Dart 525 turbine engine", says Continental engineer Harold Parker. "It is no larger than the 510, but it gives the new Viscount a take-off rating of 1990 t.e.h.p. at 15,000 rpm and raises cruising speed to 365 mph. Design refinements have increased power and lowered fuel consumption.

"Air mass flow has been increased. The addition of third stage of turbine means a lighter loading per stage and increases overall component efficiency. The flame tubes have been improved . . . service life has been lengthened to 2000 hours and more. The new Viscount is the first aircraft with a full, twin-lock propeller-pitch control system.

"The plane's greater power has made possible a take-off weight increase to 67,500 pounds—and with no adverse effects on take-off or climb performance. The ship's range is 1200 miles, or 1500 with "slipper" tanks. The airplane is designed to take advantage of the Dart 541 engines—available in 1960—which will raise the cruising speed to 400 mph."

For information, contact: Christopher Clarkson, U. S. representative, 10 Rockefeller Plaza, New York 20, N. Y.

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THE RECORD-BREAKING

VISCOUNT

1953
1954
1955
1956
1957
1958

5 RECORD-BREAKING YEARS

On April 19, 1953 the commercial Jet Age was born, with the introduction by BEA of regular Viscount service between London and Paris. Today, five years and 265 Viscounts later, this great airliner has set an impressive record as *a record-breaker!* It has set new standards of popularity, economy, speed—and passenger comfort—everywhere. 36 airlines, and numerous governments and corporations, have ordered Viscounts. They are currently flying the air routes over *every* continent.

•

35.9% PASSENGER INCREASE FOR CAPITAL

A survey, based on C.A.B. data, reports, "Capital made the industry's most substantial strides . . . with an addition of *464,426,000* seat miles . . . is now fifth in capacity offered. Capital's gain of *492,447* passengers was far in excess of the Big Four total of 250,225 and raised Capital's percentage of the total passenger market from 7.5% to *9.5%*." Based on a comparison of the first halves of 1957 v. 1956, Capital showed a passenger increase of *35.9%*.

•

VISCOUNT LOAD FACTORS SOAR IN INDIA

In *all* parts of the world Viscounts continue to set new and impressive records for passenger traffic. The Indian Airlines Corporation, purchasers of a fleet of ten Viscounts, reports that load factors rose an average of 65% on all their Viscount routes.

the same purpose as a nut on a bolt. On the DC-8, about as many Hucks are used as rivets.

DC-8 buyers have demanded custom-styled interiors for the competitive advantages they offer. Douglas has always given wide latitude to its customers in this respect but was able to reach a new extreme with the DC-8 by a number of methods of stretching basic engineering to all airplanes while allowing superficial differences to make possible great freedom of styling.

Perhaps the best example of this is the unitized seat, which, like most interior components, is Douglas designed and manufactured. Two outstanding features are its flexibility of seating arrangement and elimination of overhead passenger conveniences and utilities. Inboard end of the seat is mounted upon a floor track and the outboard end upon a sidewall track. Cold air outlet, reading lamp, writing table, oxygen masks, call button, table light and aisle light are all installed in the seat.

Interior Change Easy

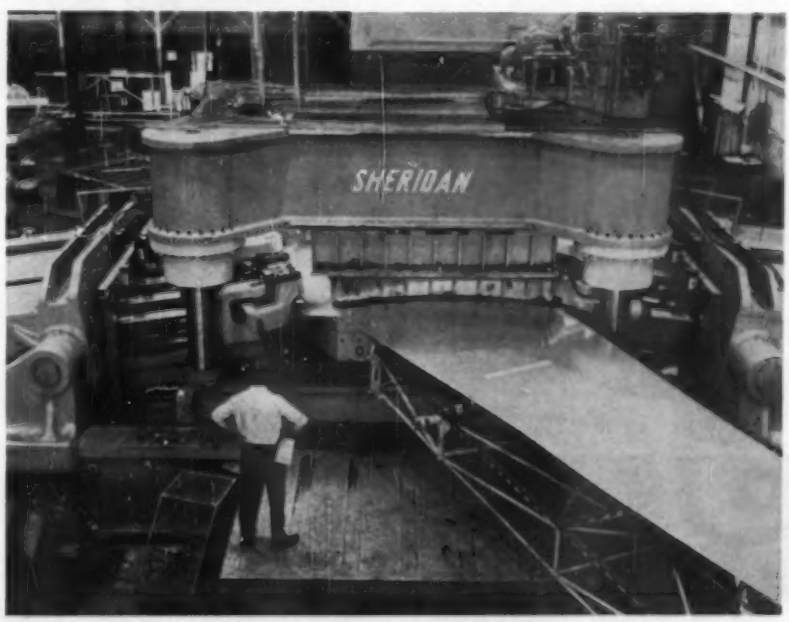
Connection with airplane electrical, pneumatic and oxygen systems is made through umbilicals at the sidewall. It is quite easy for the buyer to change his interior arrangement to serve new runs or changed business circumstances. A secondary advantage of the unitized seat is the absence of switches and outlets in the ceiling which conforms with the simplicity of line that characterizes modern interior design.

Seat is carefully engineered to survive crash loads 1½ times as great as those the airplane itself will withstand. It consists of a strong steel frame with hinged fittings and soft sheet metal panels to hold it in shape. The sheet panels have a 9G yield load at which the inboard end of the seat buckles, placing the passengers' weight close to the floor. The sidewall and floor tie-downs of the crash load bearing frame are hinged to allow the seat to move without breaking. A flexible steel strap runs up inside the back of the seat legs to hold the passenger in place after the seat has collapsed. The strap will withstand a 12G load. Index slots and holes are located at one-inch intervals along the seat tracks for positioning.

Stretched fabric ceilings and walls have been replaced by rigid lining laid in 80 in. long panels. The panels provide some mass insulation against sound and can easily be replaced. Overhead bag racks and berths are interchangeable to speed changeover if the airplane is transferred from a day run to a night run or vice versa.

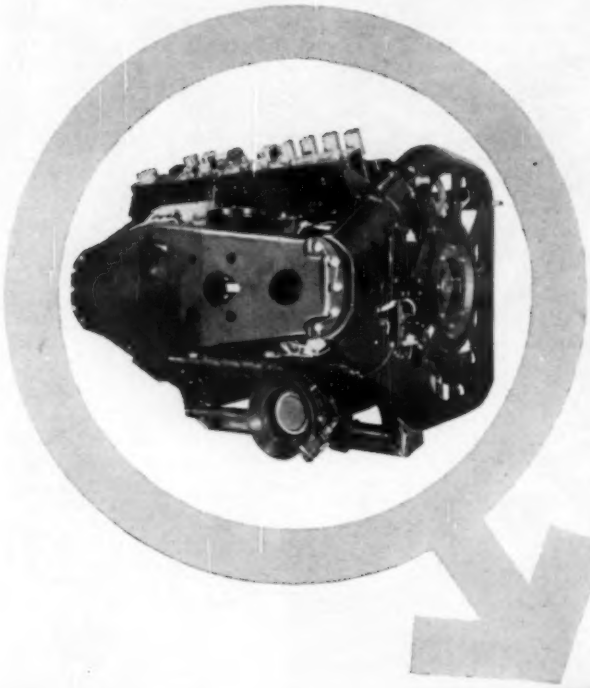
Air is supplied to the pressurized section of the fuselage by two cabin air systems consisting of four turbocompressor cabin superchargers driven by engine bleed air from the common pneumatic manifold. Any one of the turbocompressors is capable of maintaining cabin pressure. Cabin altitude is 6,700 ft. at a flight altitude of 40,000 ft.

Turbocompressors are located in the nose. A pair of inlets are below and on either side of the nose radome. Location was chosen to get them as far away from the engines as possible to avoid danger of air contamination while offering good ram recovery. Ram effect

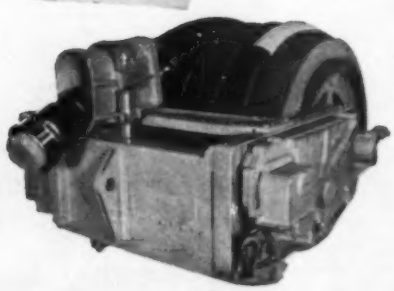


DC-8 lower wing skin section is stretch-formed to fit dihedral bend and avoid necessity of a splice at that point. Douglas claims machine is largest stretch press now in use.

SAME JOB



SMALLER, MORE EFFICIENT UNIT



Here's what design progress at Flight Refueling, Inc., has accomplished in three short years. The new, hydraulically-operated A-29 hose reel unit (bottom photo), for aerial refueling of the Navy's FJ-4 using the "Buddy" system, is far smaller, has comparable rate of flow, operates in a wider range of refueling altitudes and speeds than the larger and heavier electrically powered unit (shown at top) first put into production three years ago by Flight Refueling, Inc.

This is just an example of how applied research at FRI is solving complex fuel transfer problems in the fields of aircraft, missiles, ships and other mobile equipment.

Perhaps Flight Refueling can assist you.

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in cruise at 45,000 ft. is equivalent to a 6,000-ft. reduction in altitude.

Cabin superchargers are Douglas designed and manufactured. Douglas engineers decided to use four superchargers because two were considered a minimum requirement. One more should be available in case of a failure in flight and another should be installed to prevent the plane from being grounded by the failure before takeoff of a single supercharger.

Since fuel is the most important cost in jet aircraft operation, bleed air was chosen as supercharger power source to minimize fuel requirements. It has the additional advantages of being readily available in the airplane without the addition of anything more than the ducts.

Bleed air is drawn from a low pressure engine compressor stage in takeoff to prevent thrust loss. High pressure air used in flight is passed through a heat exchanger before entering the common manifold to bring temperature down to about 450F. Check valve prevents flow reversal if an engine is lost.

Compression Heating

No heater is necessary in the air conditioning system because hot air is available directly from the turbocompressors due to compression heating. Each turbine is driven by bleed air from 25 variable nozzles in a cam ring arrangement which allows impact angles and nozzle dimensions to be varied without changing the distance from nozzle exit to turbine. Signal from a flow sensor is used to position flow control valve. Nozzle position and exit area is automatically varied in response to changes in control valve position.

Turbocompressors draw about 210 hp. Douglas engineers were displeased about the extraction of this much power and made a thorough study of means of getting more use out of it. Recovery turbines were considered and abandoned in favor of a jet exhaust of cabin air. It was found to deliver 220 hp. Douglas engineers conclude that the additional 10 hp. is derived from the body heat of the passengers. They calculate that it adds 3-4 kt. to the speed of the airplane.

Temperature is controlled by a pair of three-ported mixing valves, each carrying air from two turbocompressors. Air from the supercharger runs unchecked through the hot air port. Cool air ports are fed through air-to-air intercoolers. Cold air is made by passing it through a vapor cycle refrigerator driven by a small 90,000 rpm. turbine with an air conditioning capacity of 13.5 tons, giving the total system a capacity of 27 tons. Vapor cycle refrigeration condenses humidity out of the air into large drops which can be gravity trapped and drained overboard. It was unnecessary to install a dehumidifier.

The two systems can maintain a

cabin temperature of 70F when outside temperatures are as low as −100F at cruise altitude. At sea level, they can hold temperature 20F below ambient by delivering conditioned air at 230 lb./min. In climatic chamber tests at Long Beach plant, the two systems have held cabin temperatures at 75F in temperatures ranging from −100F to +120F. The sidewalls are used for ducting and help control temperature by radiation. Cabin and cockpit have separate temperature control units.

Animal compartment in the forward cargo pit is temperature conditioned to 60F by cabin air exhaust which is first passed through the avionics rack to cool the equipment there. It enters the cargo pit through the double sidewalls to prevent adjacent cargo from being frozen by contact with the cold outer skin. The normal air conditioning systems were designed to eliminate smoke caused by malfunctions from cabin and cockpit without the necessity of depressurizing. It is adequate for this purpose even when operating at half capacity. Manual override control handles for the air conditioning and pressurization system are also used as position indicators in automatic operation.

With external pneumatic and electrical power, the air cooling system is capable of operating at maximum capacity and with recirculation of ventilating air, cabin compressor air heating will be adequate.

Hot air from the pneumatic manifold is also ducted through wing and tail surface leading edges in de-icing cycles. A direct bleed air blast is used to remove rain from the windshield. It operates by breaking up and partially evaporating drops to a small enough size to be carried past the windshield by the slipstream. The windshield is electrically heated to prevent the vinyl in the shatterproof glass from becoming brittle.

Oxygen Supply

Emergency passenger oxygen is stored in one 63 cu. ft. and two 48 cu. ft. high pressure bottles. It is carried to the passengers by a continuous flow system through masks which automatically pop out of the seatback in front of each passenger when the cabin is depressurized. Masks were developed by the University of Washington Medical Center in a program jointly financed by Douglas, Boeing Airplane Co., and Convair Division of General Dynamics Corp. They are made of inexpensive soft plastic and have an efficiency of 85% to 90%, according to Douglas engineers.

Oxygen for the crew is supplied by a separate breathing, diluter demand system. Crew oxygen is stored in a 73 cu. ft. high pressure cylinder.

DC-8 electrical system consists of an

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In rating the performance of the new Sensenich Model M74DR metal propeller, Cessna 170 and 172 owners insist we're too conservative. We say that this new propeller will increase the cruising speed of a Cessna 170 or 172 at least 5 miles per hour *at the same engine R. P. M. without* sacrificing rate of climb. But letters from Cessna owners who have replaced with the new Model M74DR, report up to 10% increase in propeller efficiency. We know that this propeller weighs 3 pounds less yet has a higher endurance factor. And its shorter diameter provides greater ground clearance and lower tip speeds that reduce noise and increase service life.

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independent system for each engine driven generator. In normal operation the four generators are connected in parallel through a generator tie-bus and the four systems, in effect, become one. Douglas has avoided use of automatic components more complicated than a relay and calls the system semi-automatic. When one generator comes up to speed, all four ac load buses are connected to it. The generators are nominally rated at 20 kva. but are capable of putting out 37% more power or 27.5 kva. so that any one is capable of providing power for all necessary services.

As each generator comes up to speed it takes over its own load bus until the auto parallel switch is closed and all four generators supply all four load buses. The advantage of parallel operation is that if one generator drops out of synchronization, its generator relay opens and its load bus continues to be supplied by the other three generators through the tie-bus. Unparallel operation is possible but if a generator then fails, its load must be taken by one other generator rather than three. As long as a single engine is operating there will be adequate electrical power for essential services.

Constant Speed Drives

Three-phase, 120/208 v., 400 cycle generators are turned by constant speed drives powered by accessory drive pads on each engine. Constant speed drives can hold the 400-cycle frequency constant with ±3 cycles. For finer frequency control Douglas has installed 400 cycle tuning forks for comparison by which system frequency can be held within ±1/10 cycle.

Electrical loads are divided equally among the four ac load buses. When electric powered equipment is duplicated, the separate units are tied into different load buses. Every essential load has duplicated power sources. Over 90% of electrical circuits require less than 10 amps. Higher voltage and lower current than earlier systems has cut weight and size of wires and connectors.

Four 50 amp. paralleled, unregulated transformer-rectifiers, one to each ac load bus, provide 28 v. direct current. Through the ac load buses, each dc system is connected to the tie-bus. Generators on the inboard engines supply the two emergency ac load buses as well as two regular load buses. Transformer-rectifiers for the inboard generators are hooked into the emergency ac load buses and supply a pair of emergency dc load buses as well as two normal dc load buses. Care has been taken to place only minimum loads on the emergency buses to cut number of possible failures there. Emergency systems are also supplied by the tie-bus.

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DC-8 will be fast procedure. Eight trouble indicator lights on the flight engineer's panel permit him to locate the segment of the system in which a fault occurs immediately. This means that it is seldom necessary to shut down a large part of the system. If the trouble is manifested only by a general indication such as smoke, a gang switch enables him to shut down 90% to 95% of the loads in one motion. He can then turn on individual load segments one at a time. When the gang switch is activated, the emergency buses alone remain connected.

External Power

External power receptacle for a 60 kva. ground source is connected to the tie-bus. A power relay prevents ground power from being paralleled with a generator. An indicator light at the receptacle comes on to indicate to ground personnel that the relay has opened and ground power is no longer in use. There is a special ground distribution bus with a switch near one cabin door to provide light and other conveniences for ground servicing operations without putting any time on such equipment as instruments which are needed only when the airplane is in operation.

Wiring for power and electronic circuits run on opposite sides of the fuselage to eliminate transits and interference. Wiring harnesses are laid into channels with removable covers so that the necessary wiring for new avionic equipment can easily be installed and the extra weight of spare wires need not be carried to guard against the eventuality.

A major problem in designing the avionic installations of large airplanes is antenna location. Often the best location of an antenna from the standpoint of radiation pattern is so far from the radio rack that losses in the cable are prohibitive. This often results in abandoning the best location or moving the equipment around in the airplane, which may be equally unsatisfactory. To avoid this, Douglas has developed a special coaxial cable with losses which are less than half those of standard coaxial and yet is more rugged in many respects. A typical overwater DC-8 may have as many as 20 antennas. Some of these are shared by two or more pieces of equipment, bringing the effective number of antennas to 25.

The jet transports are carrying a greater weight of avionics than earlier civilian aircraft. Every DC-8 will be equipped with weather radar identical to the units used in earlier transports except for larger parabolic reflector dishes. Four different radomes will be available for the DC-8 to suit the customer's choice of frequency and ice protection features. Glide slope antenna is located within the nose radome. The

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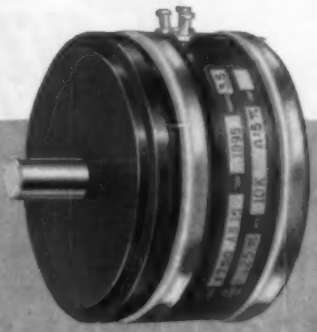

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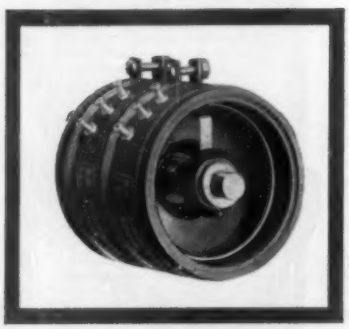

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LINEARITY: 0.5% to 0.1%
RESOLUTION: to 3900 wires

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Model 1750 (NAS-710, Style RRI8)
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lower frequency of the signal it receives is easily passed by the radome.

Many DC-8 overwater airplanes will be getting X-band Doppler navigation radars or provisions for their later installation. Two identical radars used in the Doppler system have separate antennas in a radome just aft of the cabin supercharger turbines and just forward of the nosewheel well. A few operators will require a low frequency radio teletype.

Two fuselage mounted VHF antennas are highly streamlined external stubs. Metal leading edge of the stub protects against erosion and provides a direct path to the fuselage for lightning strikes. A third VHF antenna is mounted in the tip of the vertical fin. The tail section also contains the VOR and HF antennas, and, at the customer's option, radio altimeter antennas.

Wide use of transistors in DC-8 avionics has eased the cooling problem as well as saving weight and space. Nevertheless, the mass of black boxes needed by a jet transport has demanded a cooling system capable of dissipating the heat loosed by 6,000 watts of power. Aeronautical Radio, Inc., currently specifies cooling air flow rate of 31 lb. per hour per 100 watts.

Douglas claims that the DC-8 has the best radome lightning protection in operation. This is important because statistics indicate that DC-6 and DC-7 aircraft now in operation have suffered an average of 1½ lightning strikes per year and the most vulnerable points are the nose and tail. Protection consists of small metal foil pieces embedded in the radome which provide better concentration points for the airplane's charge than the antenna housed within the radome and which cause the strike to travel along the surface of the radome into the fuselage. They do not interfere with the operation of the radar or glide slope antennas.

A problem yet unsolved in the opinion of Douglas experts is that of precipitation static. In propeller driven aircraft, cotton static wicks were installed at the wing tips to discharge at a slow enough rate so as not to interfere with radio reception. This solution is impossible for the jet transports. The number of wicks required is a function of the square air speed. A Douglas engineer estimates that the DC-8 would require 131 wicks spaced at intervals not less than 18 in. Using this estimate, the wings are not long enough.

DC-8 has a 3,000 psi, closed center (always pressurized) hydraulic system which is very similar to those used in the DC-6 and DC-7 series airplanes.

Power for the system is supplied by two variable displacement pumps, one mounted on each inboard engine. Total flow in the system is 45 gpm. Variable

displacement pumps are used rather than constant displacement pumps with separate pressure regulators because of the demands of the hydraulic powered rudder and ailerons for constant pressure with fluctuating load. They make it possible to size components for full pressure rather than for 2,600 psi., which is the lower limit of regulator setting.

Pump selected was designed for 4,000 psi. with oversize bearings and heavy duty components. Douglas expects to get 1,800 flight hours per unit before overhaul. By cutting out alternate pumps in the cruise portion of alternate flights, it should be possible to stretch this period. An emergency electric pump with a capacity of 3.1 gpm. is supplied by a separate fluid reserve.

System reservoir in the left wheel wall is pressurized to 45 psia. to permit cold starts and high altitude operation. Of its 12 gal. capacity, 2.5 gal. are held in reserve for the electric pump.

Main wheel brakes of the DC-8 are nearly identical to those of the DC-6 and DC-7 except for size and valve location. Full application of a brake requires no more than 0.2 sec. Two 7½-in. spherical DC-7 accumulators are installed in the brake system to provide power for three full applications and one application at 1,000 psi. They will also be able to hold parking pressure for at least eight hours. Brake torques on the four main wheels are segregated so that one has no effect on the other. Lockout cylinders allow half of braking to be retained if there is a failure in one branch of the system.

Braking loads are the criteria by which the landing gear were designed. Spin-up and spring back loads were found to be comparatively negligible. A foot slapper skid detection device based upon an inertial sensor measuring angular deceleration of the wheels will be installed. Modulating emergency air brakes will be used. Aerodynamic spoilers interlocked to the nosewheel shock strut and fast retracting flaps are used to dump lift and get weight onto the wheels quickly.

Wing flaps are powered by six actuators, one on each inboard section and two on each outboard section. Multiple actuators cut torque loads and save structural weight in the flap.

Identical except in size are the hydraulic power units for the rudder and ailerons. Aerodynamic control tabs are locked in neutral by normal hydraulic pressure. Loss of pressure automatically frees the tab and causes the system to revert to aerodynamic boosted manual control. Pressure in flight control lines is automatically shut off completely if it drops below 1,100 psi. There is also a manual override to eliminate powered control at the pilot's option.

Here is a cast aluminum access door for an aircraft fuel cell. Of special interest is the fact that in its flat area the thin section is held to 0.080" ± .010", yet it is pressure tight. Grooves for sealing gaskets are cast in to eliminate machining; the fuel cell access door is used as cast.

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Navy Evaluates Solid Propellant Drone

By Craig Lewis

Dallas—Transonic, rocket-powered drone is being evaluated by the Navy at the Naval Air Missile Test Center as a means of providing more realistic flight targets for high performance weapon systems.

Designed and built here by Temco Aircraft Corp., the air-launched XKDT-1 Teal uses a dual-thrust solid rocket motor developed by Astrodyne, Inc., to give it flight durations over eight minutes at speeds close to Mach 1 and at altitudes up to 55,000 ft.

Teal is one of the drones Navy is investigating in an effort to give its pilots training targets that are more realistic simulators of current combat aircraft. Design stems from a 1955 Navy competition for a low cost, expendable, high performance target drone.

Prime factor in Teal's performance is the solid fuel rocket engine designed by Rocket Fuels Division of Phillips Petroleum Co. Last February, Rocket Fuels Division was absorbed by Astrodyne, Inc., a new subsidiary of Phillips and North American Aviation, Inc.

Dual-Thrust Motor

Drone's rocket motor employs a new dual-thrust system in which booster and sustainer phases are bonded into a single solid propellant grain. Ammonium nitrate base propellant is formed into an end-burning cylindrical charge design.

Boost phase of the charge gives the drone about 150 lb. of thrust for 3.8 sec. to assist in the air launch and carry it to altitude. Sustainer phase provides about 50 lb. of thrust for a few seconds over eight minutes. Boost phase is a disk of higher burning rate propellant bonded to the aft end of the sustainer grain.

Use of the ammonium nitrate propellant gives the Navy a fuel that can be stored for long periods in the sealed engine case at atmospheric pressure. Solid propellant's simple logistical qualities also make it ideal for shipboard use.

Engine case is an integral section of the drone's fuselage. It is 59 in. long, and 10 in. in diameter. A 29 in. blast tube carries exhaust gas through the tail section of the drone to a nozzle insert at the aft end. A thin copper starter disk on the nozzle insert helps ignition by permitting pressure to build up before nozzling begins; it also provides a moisture seal.

Blast tube is made from mild steel tubing with 0.07 in. wall thickness. Engine case shell is formed from 0.090 in. 4130 steel sheet. Pressure vessel is bound by three intermittently welded reinforcing rings which stiffen it and distribute attachment loads. One launch hook is attached to the forward ring and two to the aft ring. A wing attachment stud is mounted on the forward ring and two are on the middle ring.

Casing Wall

Outer wall of 0.032 in. aluminum covers the case, and launching hooks and wing studs extend through holes in it. Flanges on either end of the case are machined and drilled so nose and tail sections can be attached.

Five sections of the XKDT-1 fuselage can be replaced in the field. Nose cone section is Fiberglas, and this is followed by a one-piece rolled magnesium center section which houses the autopilot. This attaches to the rocket engine case.

Aft of the rocket engine is a magnesium casting which includes vertical and horizontal control surfaces and houses electrical servo actuators. Fiberglas tail section is an aerodynamic fairing and a cover for the engine exhaust tube.

Drone's swept wing is made of aluminum honeycomb sandwich structure. Honeycomb cores are milled to the correct contour, then the one-piece aluminum skins are stretch-formed to fit.

Wing is bonded as a single unit which can be installed on the engine case with three flush nuts.

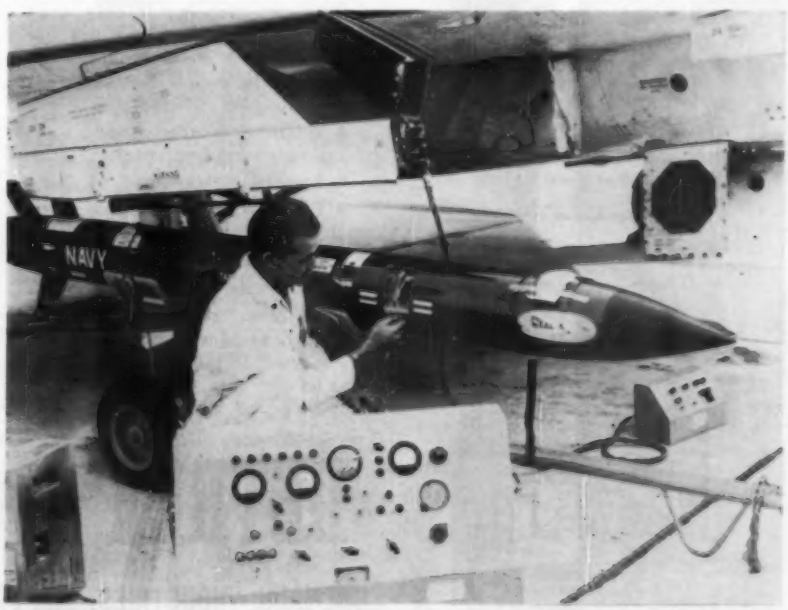
Control surfaces are machined from magnesium forgings and driven by internal cranks attached to electrical screw jack actuators. Nose and tail cones are formed in one piece and contour-milled to control thickness and permit efficient radar penetration to the corner reflectors inside. Corner reflectors augment radar signals reflected by the drone.

Teal uses the corner reflectors to simulate a more realistic radar "bogey," and infrared radiation is improved by use of infrared flares. Miss distance indicator fires a marker flare when a missile passes within a certain distance of the drone.

Visual Tracking

XKDT-1 also has a visual tracking system. It ejects visual tracking or identification flares intermittently during the powered phase of its flight to help pilots find, identify and track it.

In the future, Teal may also be equipped with the Radar Echo Aug-



TEMCO XKDT-1 target drone is readied for flight at Naval Air Missile Test Center, Pt. Mugu, Calif. Drone's rocket engine is powered by solid propellant fuel. Console checkout is being completed here before attaching XKDT-1 to McDonnell F3H-2M fighter.

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XKDT-1 Teal Data

Wing span	58.8 in.
Overall length	11 ft., 9.5 in.
Maximum fuselage diameter	10 in.
Flight weight	350 lb.
Span of horizontal surface	29 in.
Wing area	6 sq. ft.
Aspect ratio	4
Root airfoil	NACA 004-64 (Mod)
Tip airfoil	NACA 004-95 (Mod)
Sweepback at quarter chord	35 deg.
Maximum speed at 50,000 ft.	Mach .95
Operational altitude	SL to 55,000 ft.
Powered flight duration	8 min.
Propulsion	Astrodyne two stage rocket, solid propellant fuel.

mentation Device (READ) developed by Temco. This unit was designed to make stronger radar images of aircraft and missiles. It would make the relatively small drone appear more the size of an enemy tactical aircraft on the scope of an interceptor using it as a training target.

Autopilot Control

Temco drone has an autopilot stabilization system to control heading and altitude. It is electrically operated and uses no hydraulic or pneumatic power. Electrical power comes from a 28 v. battery.

Control system has a roll and yaw gyro, a pressure-sensitive altitude controller, servo amplifiers, motor timer and mixing networks. Pressure changes caused by variations from altitude are sensed and corrective signals are sent to the elevators. Gyro senses roll position and yaw errors, and corrections are made with differential elevators and rudder.

If Teal components malfunction or the drone deviates too much from its pre-set course, a self-destruct system automatically dives it to earth.

Console Checkout

Temco-designed console is used to check out XKDT-1 systems before flight. Vacuum line to the static ports checks altitude control, and complete dry runs of all systems can be made with the checkout console. A second, smaller console checks out the launching system.

Flight tests of the Teal have been made from F3H launching aircraft. Drone uses a trapeze type launcher designed by Temco. It is pneumatically actuated and adapts to standard Navy air-to-air missile pylons. Launching system uses existing missile launching selector switches.

Adequate clearance between drone and launching aircraft is provided by giving the drone an initial forward velocity relative to its launcher.

Units Test Missile Weight, Balance

Automatic determination of weight and balance data in production of small missiles is providing improved quality control at reduced production costs.

Weight and balance check, final operation in missile production, is made to detect out-of-balance missiles, which experience tumbling or otherwise inaccurate trajectories.

Manufacturers with devices in the field include the Electronic and Instruments Division of Baldwin-Lima-Hamilton Corp., Waltham, Mass., and Dynametrics Corp., Burlington, Mass. Baldwin-Lima-Hamilton's system is used in production of the Hughes GAR-1 Falcon air-to-air missile at the Hughes plant in Tucson, Ariz. Dynametrics is marketing a weight and balance device available as a single unit.

Weight and Balancing

Baldwin-Lima-Hamilton calls its equipment the aircraft weight and balancing system. Substantially more accurate than mechanical weighing methods formerly employed at Hughes, it also is reported to be much faster, saving money in terms of man hours per missile. Based on the system's first six months of operation, Hughes estimates that the $74,000 machine will amortize the investment in 3½ yr.

System consists of two major units: instrument console and missile platform. Located on the platform are two specially designed Baldwin-Lima-Hamilton SR-4 sensing elements and one standard SR-4 load cell. Information obtained from the load cell and strain gage beams is automatically printed on a weight and alignment data chart.

Device assesses each missile in terms of certain pre-set standards. It does the following things automatically: measures missile's weight to an accuracy of 0.1016 lb., finds longitudinal center of gravity to accuracy of .015 in., determines lateral center of gravity to accuracy of .002 in., measures thrust alignment to accuracy of .002 in., repeats measurements on same missile to accuracy of .0005 in.

Thrust alignment is the lining up of the missile's lateral center of gravity within close proximity to the center of thrust. Slight adjustment of the Falcon missile's rocket motor can be made to provide some compensation.

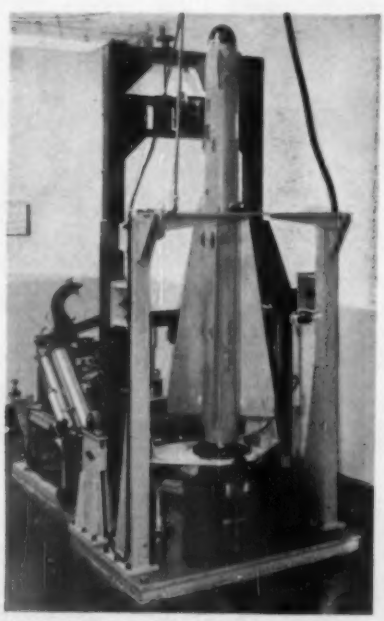
First step in the Falcon test procedure is to place the missile horizontally on the platform. Resting horizontally on the load cell, missile's weight and longitudinal center of gravity are automatically recorded. Lateral center of gravity is obtained by making two measurements, both while the missile is in the horizontal position. Initial measurement—lateral center of gravity X—is made. Missile is then rotated 90 deg. around its long axis, and a second measurement—lateral center of gravity Y—is made. Summation of these two measurements, plotted on a Moseley X-Y plotter, is recorded as the lateral center of gravity.

Alignment Measured

Next the 125 lb. missile is raised to a vertical position and lowered onto a mandrel serving as a thrust alignment fixture. Thrust alignment is measured by two bonded wire strain gage beams attached to the mandrel. Deviation is measured by the machine which measures the distance in inches between the missile's true center of gravity and the point at which the true vertical, the projected center line of the SR-4 pickup, intersects the longitudinal center of gravity line.

Strain gage beams, operating on the basis of inverted pendulums, provide separate pickups for deviations in two right vertical planes through the longitudinal axis of the mandrel. Resultant of two pickups is charted by the Moseley plotter. Recording of thrust alignment completes the five-minute weight and balancing determination procedure.

Dynametrics is marketing a unit for weight and balance determinations known as the Mk. V weight and center of gravity locator. Offered as a single unit, it is an application of an electromechanical force beam developed for determining forces and moments acting on wind tunnel models.



AUTOMATIC unit tests Falcon.

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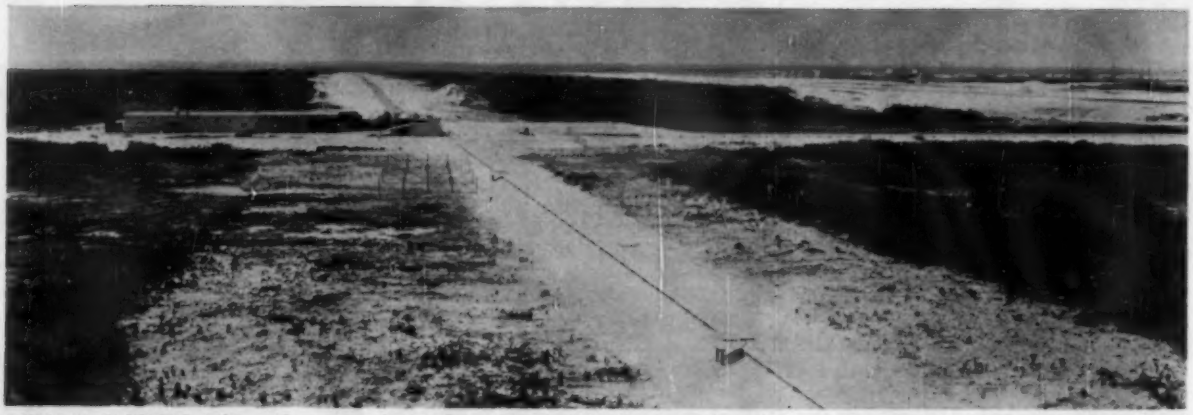


GENERAL ELECTRIC Atlas guidance complex at Cape Canaveral includes Doppler radar transmitter located at center of a cross-shaped configuration with receiving stations located at the end of each of four legs of the cross (cleared areas running from left to right of photo, and diagonally from top to bottom). Comparison of signals received at four stations enables Burroughs computer to calculate missile's velocity, acceleration and displacement. Doppler radar network originally required 5,000-ft. base legs, but newer versions are decreased.

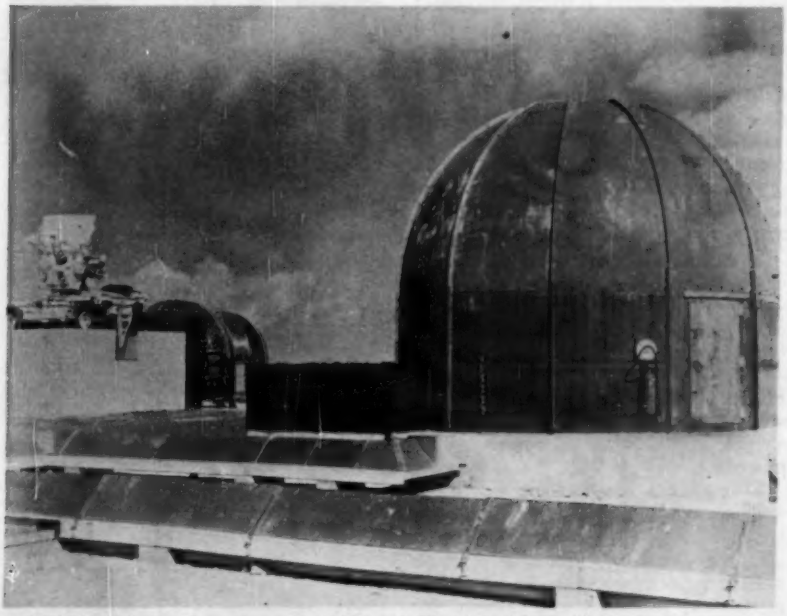
How Command Guidance Controls Atlas

By Philip J. Klass

Washington – Command guidance system used with the Atlas intercontinental ballistic missile is expected to have an accuracy which equals, possibly exceeds, the six-mile figure recently claimed for the Soviet ICBM by Maj. Gen. G. I. Pokrovsky, as reported by Tass, official Soviet news agency.

Use of command guidance is expected to give the Atlas an accuracy which is three to 10 times that of the inertially guided Titan ICBM, according to qualified experts. However, use of inertial guidance will give Titan certain operational advantages, including the capability of mass salvo launchings which is not feasible with command guidance.

Based on Gen. Pokrovsky's description, which appeared in an article in a Soviet youth magazine, Russian ICBM appears to be a radio beam-rider, possibly in combination with inertial guidance, a technique tried by the Germans during World War II.



PRECISION radar tracker, also part of General Electric's Atlas guidance system, measures missile's azimuth, elevation position and slant range. Tracking radar is pulse type.

Responsibility for developing Atlas guidance system is divided between General Electric Co. and Burroughs Corp. General Electric is responsible for the tracking, measuring and ground-to-missile data transmission, while Burroughs is building the ground-based computation facility which calculates missile trajectory and the changes in flight path needed to hit the target.

• **General Electric** activities are centered in its Missile Guidance Product Section, Syracuse, N. Y., a group set up especially for this project. Headed by Richard Shetler, the group is under the company's Heavy Military Electronic Equipment Department. Current employment is about 2,400, of which one-quarter are engineers and scientists. Employment is expected to reach 3,200 by end of the year.

• **Burroughs** carries out its development work in its research center at Paoli, Pa. Center's Ballistic Missile Division, headed by Edward Lohsi, employs about 500 persons, of which roughly 25% are engineers. Scope of the program can be gained from definitive contract awards officially announced–General Electric: $83 million; Burroughs: $37 million.

Both General Electric and Burroughs officials are reticent about details of the Atlas guidance system and how it functions. However, system is believed to consist of:

• **Doppler radar,** consisting of a ground transmitter and a network of four receiving stations laid out in the configuration of a cross, with one receiver located at the end of each leg of the cross. Measurement of the familiar Doppler

frequency shift at each of the four receivers and comparisons between them make it possible to determine missile's vertical velocity and its translational velocity and acceleration over the ground.

• **Precision tracking radar,** pulse-type, used to determine missile's azimuth and elevation position and slant range.

Signals from the two radar systems feed the Burroughs digital computer which continuously calculates missile's trajectory, compares it with desired target trajectory, computes required flight path corrections and point of fuel cut-off. Latter is transmitted to Atlas via General Electric equipment, possibly using radio data link or by modulation of tracking radar signal.

Because of attenuation (as much as 40-50 db.) of radar energy by rocket engine exhaust gases, missile is believed to carry a radar transponder to enhance both Doppler and tracking radar signals.

Ramo-Wooldridge Corp., which serves as technical manager of the Air Force's ballistic missile programs, is responsible for overall guidance loop stability and for developing basic guidance equations employed by the Burroughs computers.

Tracking radar cannot be used during initial portion of Atlas ascent because of reflections from the ground. During this brief interval, Atlas is guided by its gyro-stabilized autopilot, which also provides vehicle stabilization during remainder of powered flight. For this reason the Atlas guidance system sometimes is referred to as a "radio-inertial" system, although it is hardly an inertial guidance system in the fullest meaning of the term.

There are a number of potential advantages and disadvantages of command guidance compared to all-inertial guidance for an ICBM, which explains why the Air Force is hedging its bets by exploring both. Titan is being designed to use either an all-inertial system developed by American Bosch Arma Corp., or a command guidance system developed by Bell Telephone Laboratories, Inc., and Sperry Rand Corp.

Advantages of command guidance for intercontinental ballistic missile guidance include:

• **Greater accuracy,** estimated at between three and 10 times better than existing all-inertial systems.

• **Continuous ground control** of missile exists during powered flight, together with continuous computation of its destination. Missile's warhead is "armed" by radio control only when ground computer indicates ICBM is following its planned trajectory. Missile can be destroyed from ground if it fails to make good its intended course.

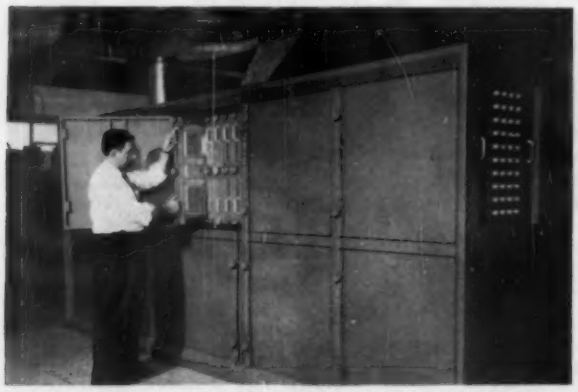
• **Airborne equipment size and weight** is appreciably less for command guidance than for inertial, permitting larger warhead. Cost of airborne equipment also is considerably less than for inertial guidance.

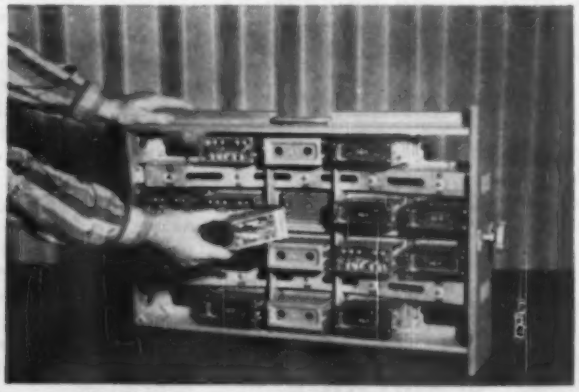
• **Greater sophistication** and accuracy can be built into ground-based command type digital computer than into the all-inertial airborne computer because of size, weight considerations.

On the other hand, an all-inertial ICBM has the following advantages over one employing command guidance:

• **Mass salvos** of missiles can be fired simultaneously, whereas a command guidance complex presumably can han-

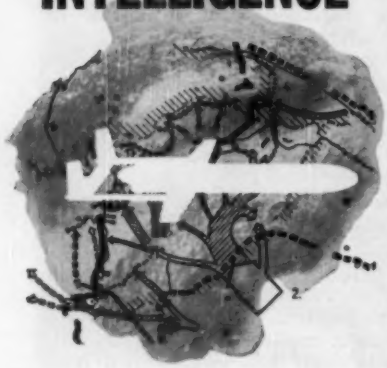
AUTOMATIC Burroughs checkout panel permits rapid trouble shooting of faulty elements (left). Test console for Atlas computer (right) enables operators to check performance with sample problems. Computer is transistorized except for electro-mechanical punch equipment.





ATLAS guidance computer (left), designed and built by Burroughs Corp., employs plug-in trays which permit speedy change of ballistic missile targets and quick computer repairs. Plug-in construction is employed in sub-assemblies (right) used in Burroughs computer tray.

INTELLIGENCE



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dle only a single Atlas in powered flight at any time, unless latter has dual guidance systems installed.

• **Enemy jamming** of inertially guided missile is impossible, so far as is known, but command guidance radar and radio are potentially vulnerable to enemy countermeasures. However, General Electric spokesman says that considerable effort has gone into minimizing this possibility. He indicates that Atlas cannot be jammed from distances beyond line-of-sight, and that at closer ranges the enemy would have to practically move its electronic countermeasures transmitter alongside the launching site—an unlikely prospect. General Electric says in its tests to date it has been unable to jam Atlas guidance.

• **Signal radiated** by ICBM transponder, assuming one is used, could provide a beacon which makes it easier for enemy defense radars to detect the missile, compute its trajectory and intercept it in subsequent flight.

• **More real estate** is required for an ICBM base using command guidance than for one equipped with inertially guided missiles. Originally, General Electric's Doppler radar network required base legs each 5,000 ft. long. However, in newer versions company has achieved a "substantial decrease," according to Jack Records, engineering manager of the missile guidance section.

Maintaining an Atlas guidance complex in a continual state of readiness, with a high degree of assurance that it will function properly if the "panic button" is pushed, has been one of the most challenging aspects of the Atlas guidance system design.

Burroughs computer, for instance, is designed to run through representative guidance problems at frequent intervals, comparing the results with the known answer. If computer does not come up with the correct answer, it automatically switches to a taped program designed to diagnose the trouble and isolate it down to a major assembly on a quick disconnect tray which can be speedily replaced, according to Dr. Irven Travis, Burroughs vice president for research and engineering.

Problem of ascertaining whether the General Electric guidance radars are in operating condition is a little more difficult. General Electric has designed equipment so that key voltages throughout the system are continuously monitored. If one falls outside acceptable limits, a flashing light immediately indicates this fact and shows which element must be replaced.

Most difficult part of the Burroughs computer development was to achieve the phenomenal reliability set forth by USAF specifications, according to Richard Mathes, manager of equipment design.

Computer is completely transistor-

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ized, except for a handful of tubes used to drive electro-mechanical punch equipment. In the belief that transistors today are more reliable than resistors and capacitors, Burroughs developed direct-coupled transistor logic circuits which eliminate many of the resistors and capacitors previously employed in computer circuits. Total of nearly 20,000 transistors is used in each Atlas guidance computer.

Estimated 10-15 engineering man-years were spent on reliability studies of the approximately 10 basic circuits which make up the bulk of the computer, with additional effort to minimize number of connectors and pins, according to William Dombert, head of mechanical design.

Printed circuitry is widely used in the small plug-in modules which make up the larger removable tray assemblies. Modules are sealed, gas-filled, have gold-plated contacts.

Each soldered connection, of which there are several hundred thousand per computer, is individually inspected for quality. As each connection is approved, it is coated with a dot of special red paint. If connection should subsequently be exposed accidentally to a soldering iron in the process of maintenance, which might weaken the connection, the red dot disappears, making it easy to spot the damage.

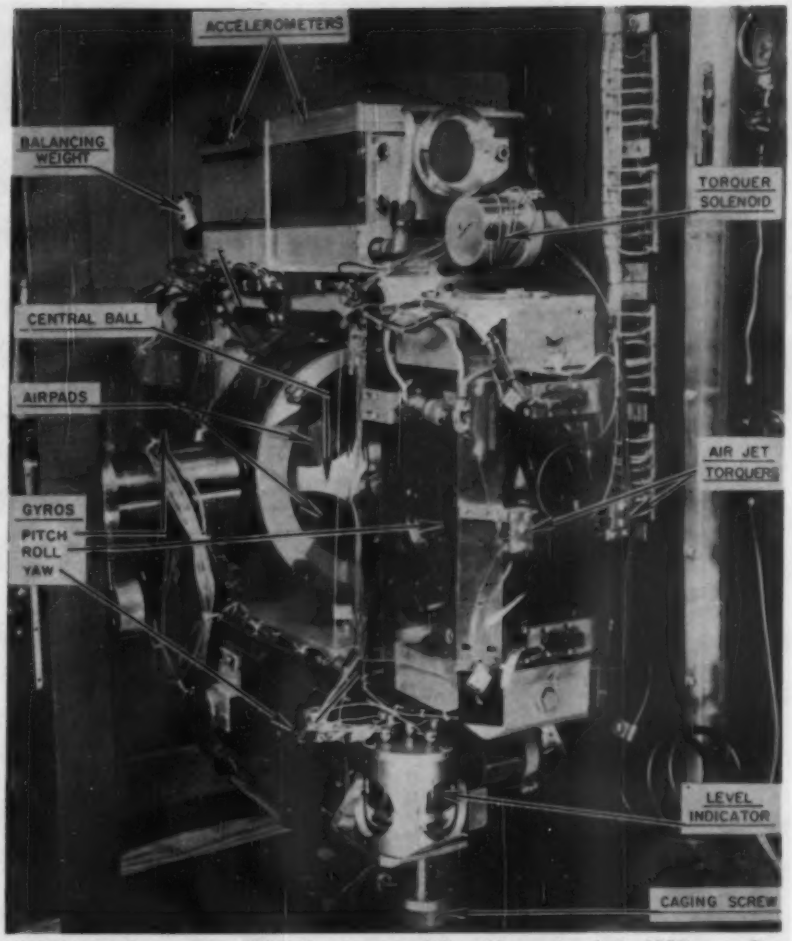
At General Electric's Missile Guidance Section, every single circuit is reviewed by one or more members of a team of experienced designers who look for possible mis-application of components, lack of sufficient safety factor in component ratings or other potential causes of unreliability.

Full-time tube specialist is employed to serve as a consultant to circuit designers. (Company is using tubes predominantly in existing design but has some transistorization under development.)

An "Action Memo" from Burton Hatch, manager of systems reliability and standards, to any designer carries the authority of the manager of engineering. Designer must either accept reliability recommendation made by Hatch's group or else present evidence defending his position.

Reliability group establishes what manufacturers' components can be used, maximum safe ratings and other application limitations. Wherever possible, engineering prototypes must be constructed using approved components and the reliability group even has veto power over the components purchased by the engineering laboratory's stock room.

General Electric, one of the first companies to use the now-popular quick-check type of cards for reporting field failures of avionic equipment and causes of failure, has developed new type of card designed to provide an hour-by-hour performance profile of the major elements in the Atlas guidance system.



INERTIAL guidance system XN-1, first to successfully guide an aircraft (in 1950), according to North American Aviation's Autonetics Division, employed three air-bearing, single-degree-of-freedom gyroscopes, two integrating accelerometers. Novel characteristic of the system was the use of air-jet torquers instead of electric motors to keep the platform stabilized.

When field engineer or maintenance man makes regular hourly checkout on major system elements, he fills in the card using special pencil whose marks can be read automatically by machine when card is returned to Syracuse. Position of pencil mark indicates hour of the day and the status of the sub-system in one of 10 categories, i.e. operating satisfactorily, operating at reduced capability, inoperative, under repair. After machine analysis of these cards at Syracuse, summary sheets are automatically prepared which give such information as total down time for repairs, out-of-commission time, mean time between failure.

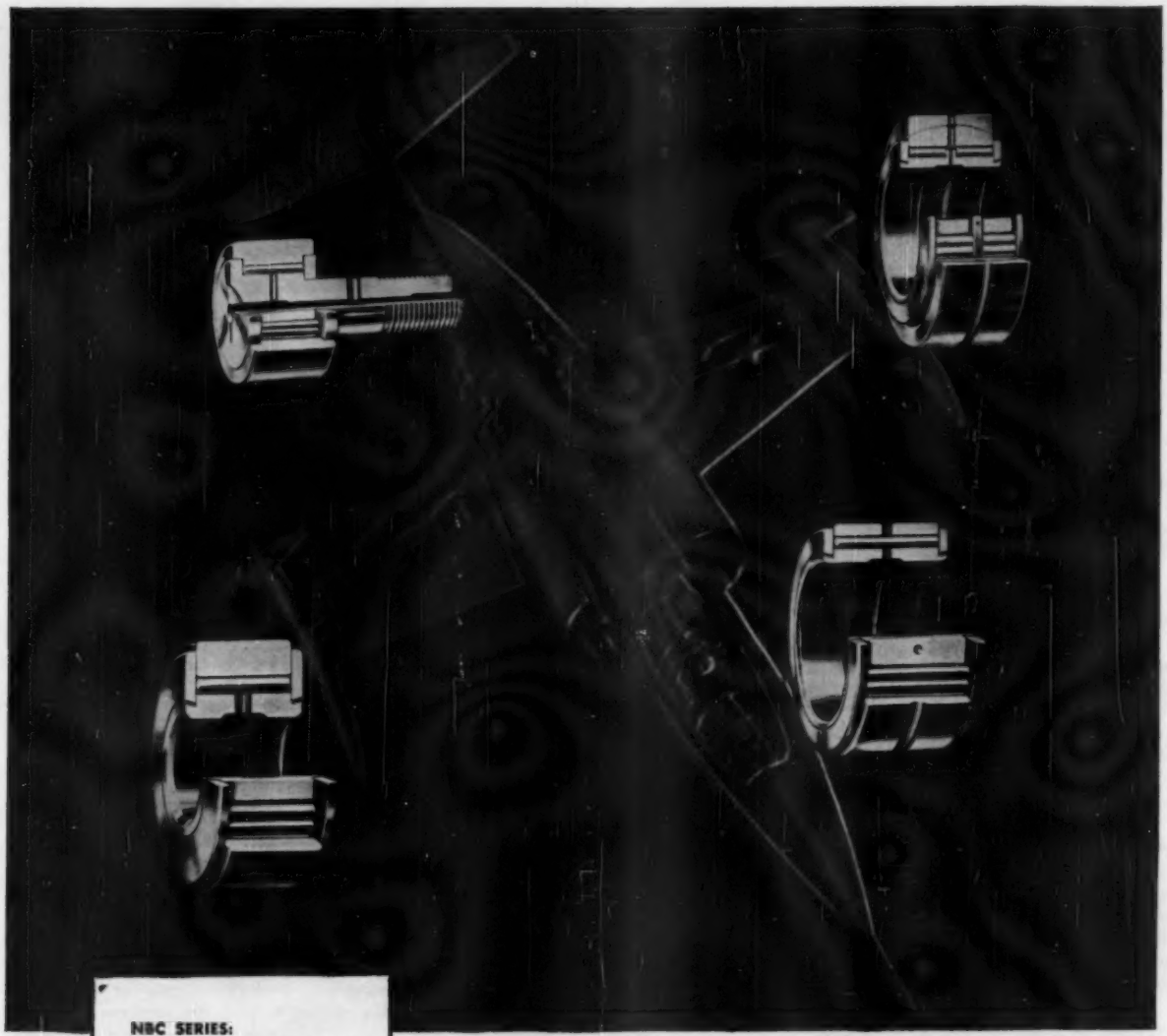
Performance profile card data gives a realistic appraisal of service performance and reliability, enables General Electric engineers to gage how long it takes to diagnose and cure malfunctions, provides information which is helpful in predicting spare parts requirements, according to Richard P. Landers, of General Electric.

General Electric has set up a supply and overhaul depot for Atlas guidance in Syracuse, adjoining its Missile Guidance Section headquarters.

Depot will be operated by company personnel initially, until Air Force personnel can be trained to take over the function.

More than a dozen major subcontractors are working with General Electric on the Atlas guidance program. List includes:

- **Aircraft Armaments Inc.**: simulator cabinet.
- **Ampex Corp.**: tape recorders.
- **Dalmo-Victor**: antennas.
- **Electronic Engineering Corp.**: recorders.
- **General Bronze Corp.**: antenna.
- **Goodyear Aircraft Corp.**: radomes, antenna assemblies.
- **Henney Motors**: trailers.
- **Machlett Laboratories**: tubes.
- **National Co.**: measuring sets.
- **Nuclear Products**, ACF Industries Er-



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• **University of Chicago:** study of interference and anti-jamming.

• **Varian Associates:** klystron tubes.

Several other General Electric departments, including Missile & Ordnance Systems, also are participating in the program.

Expansions, Changes In Avionics Industry

Radiation Inc., Melbourne, Fla., has formed new Astrionics Division which will be responsible for research and development of instrumentation systems for application to long-range missiles, satellites and space exploration. New division will be headed by Lawrence Gardenhire. **Lear Inc.** has announced formation of Astrionics Division, located in Santa Monica, which will be responsible for flight control and guidance systems. James P. Brown is named general manager of new division. Other recently announced changes and expansions in the avionics field include:

• **American Measurement & Control, Inc.,** Waltham, Mass., is name of newly formed company which will develop and manufacture instruments and controls. New firm, located at 240 Calvary St., is headed by Donald G. O'Brien.

• **Leach Corp.** has opened new $1.5 million 101,000 sq ft. manufacturing

engineering facility in Compton, Calif. Facility employs 300 persons, is expected to grow to 500.

• **Westinghouse Electric Corp.** has established new applied research laboratory for development of "radically different electron devices," including electron tubes, solid-state devices, microwave tubes and information storage tubes. New laboratory, located in Baltimore, is headed by G. Ross Kilgore, former director of Army Signal Corps Electronic Device Division.

• **Genistron, Inc.,** Los Angeles, is name of new company which will design and manufacture precision filters. Company is owned by Fred J. Nichols, president, Millard Porter, Jr., vice president-engineering, and Genisco Inc. with latter holding majority interest. Address is: 2301 Federal Ave.

A 20th-scale flutter model of Convair's jet 880 mounted in the transonic test section of the CWT

The 880 and the CWT

With its swept wing and powerful, turbojet engines, Convair's 880 jet transport is designed to operate from airports used today by 4-engine, propeller-driven planes.

The world's fastest commercial jet airliner, the 880 will cruise at 615 mph, at altitudes up to 40,000 feet. It will operate economically over route lengths from 250 to 3,250 miles. Scheduled to go into service in the spring of 1960, the new jet transport will be able to land and take off from at least 335 existing airports in the United States, Alaska and Canada.

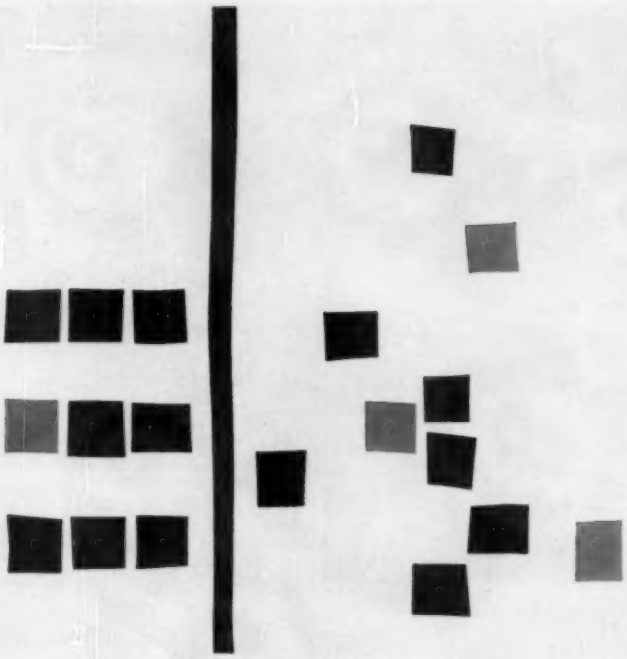
CWT—the Southern California Cooperative Wind Tunnel—has participated in the aerodynamic testing of the 880 over a two-year period. With its multi-million dollar facilities and staff of 240, CWT has helped develop many of the nation's most important aircraft and missiles.

The CWT serves its five owner companies, a number of governmental agencies, and other aircraft manufacturers. If you would like more information regarding its services and facilities—or employment opportunities—you are invited to write us.

CWT SOUTHERN CALIFORNIA COOPERATIVE WIND TUNNEL

950 S. Raymond Ave., Pasadena, California

Operated by the California Institute of Technology. Owned by Convair, Douglas, Lockheed, McDonnell and North American.



THE
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FREEDOM

and the System Designer

Freedom is doing what you like. Some System Designers like best to match their wits and skills against difficult problems. This characteristic (or idiosyncrasy) of liking complicated technical problems is one of the chief qualifications of the engineer we need.

The advanced nature of the assignments requires at least four years' experience, including circuit design or development, equipment construction and a knowledge of logical design for computers. Moreover, the position also calls for a sound background in computer programming, the ability to write programs and familiarity with the IBM 700 series or similar single address parallel machines.

You are invited to write for more information or phone collect. Address R. W. Frost, System Development Corporation, 2404 Colorado Avenue, Santa Monica, Calif.; phone EXbrook 3-9411.

SYSTEM DEVELOPMENT CORPORATION

An independent nonprofit organization, formerly a division of the Rand Corporation

Semiconductor Unit Regulates Current

New semiconductor component which performs as a current regulator in circuits where supply or load voltage varies over wide limits has been developed by Bell Telephone Laboratories Inc. The two-terminal device's high ac impedance makes it also useful as a coupling choke or ac switch, the company reports.

Field effect varistor, as device is called, contains a single planar junction made by diffusion process. (Fig. 1.) As voltage applied across terminals is increased, current increases until pinch-off voltage is reached, after which current remains constant within approximately 1% until breakdown voltage is reached (Fig. 2).

Bell has built silicon units with pinch-off voltages of 10 v., breakdown voltages of 150 v., regulated current level of one milliampere.

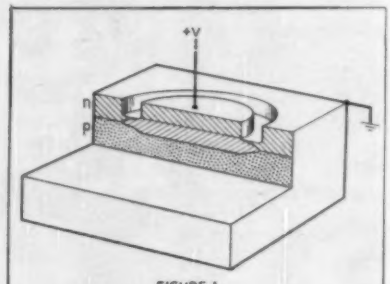


FIGURE 1

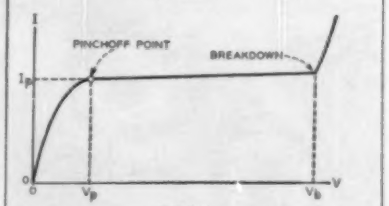


FIGURE 2

Germanium units have exhibited pinch-off of 10 v., breakdown of 25 v., 10 ma. regulated current.

Bell Telephone Laboratories says it now appears possible to build field effect varistors with regulated current values ranging between 10 microamperes and 10 milliamperes, and improved techniques may permit still higher current levels.

A parasitic shunt capacitance of a few micro-microfarads must be taken into account in circuit application, the company cautions. In constant current region, ratio of ac impedance to dc resistance is about 100, but may run as high as 1,000. Field effect varistor differs, however, from conventional coupling choke in that its ac impedance remains constant over appreciable frequency range.

TV Cockpit Display Creates VFR Effect

Highway in the sky, newest addition to Office of Naval Research TV-tube cockpit display, shows aircraft position and altitude relative to desired flight path by means of a "white highway" which moves toward pilot to give illusion of airplane progress. Black-white circles, at each side and center, also appear to move toward pilot at speed proportional to airplane's ground speed, giving illusion of contact flight.

When airplane is above and to the left of desired flight path, such as localizer and glide slope beams during instrument approach, cockpit screen would appear as shown. Angle of horizon indicates airplane is banked to the right.

Variety of flight displays, including climbing turn shown, can be presented using display generator developed by Kaiser Aircraft & Electronics. Desired flight path for particular phase of mission is computed by lightweight airborne digital computer, developed by Litton Industries.

USAF Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Air Force Contracting Offices:

HEADQUARTERS, SAN ANTONIO AMA, USAF, Kelly AFB, Texas.

Champion Spark Plug Co., Toledo, Ohio., 4708-FS-43-2, plug igniter, 2,000 ea., item used in support of 0230-57160 power plant; (RFP PR: SA-8-03H-1731), $33,402.

NASCO, Inc., Miami 48, Fla., spare parts and component parts in support of 9407-24G3-200A generator, 266 to 400 ea.: (RFP PR: SA 715472-1 and -2., $149,658.

HEADQUARTERS, AIR FORCE MISSILE TEST CENTER, ARDC, USAF, Patrick AFB, Fla.

Dynatronics, Inc., Orlando, Fla., 200 volt dc power equipment, (PR: 58-1030, contract AF-08(606)-2521), $52,035.

HEADQUARTERS, DAYTON AFD, USAF, Gentile AFS, Dayton 10, Ohio.

Jennings Radio Corp., San Jose, Calif., capacitor-var vacuum diel., Jennings Radio type UCS500, Deg. no. 265-1A, 180 ea., capacitor-var vacuum, diel., Wemco style 1472826, appl: radio transmitter type MW, 30 ea., capacitor-var vacuum diel., Jennings Radio type UCSL250, 25 ea., RFP 33-604-58-1710, $30,480.

Iron Fireman Manufacturing Co., Electronics Division, Portland, Ore., relay, armature, p/o USAF radar fire control system type #E4, Hughes Aircraft 950008-3; Iron Fireman type R. S. 500-3-1, 4K,300 ea., RFP 33-604-58-1657, $41,215.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., relay assembly, Minneapolis-Honeywell P/N RG12C-2, 150 ea., RFP 33-604-58-1772, $27,805.

Raytheon Manufacturing Co., Waltham, Mass., tube, electron, magnetron, type 6249A a/w, Spec. MIL-T-8128A(USAF) dated April 10, 1956, 5,700 ea., IFB 33-604-58-402, $1,935,862.

Electro Mechanical Division, General Riveters, Inc., Buffalo, N. Y., antenna, subassembly, Bendix Aviation, RCA P/N 1015546X, appl: AS-42SA/APS-42A, 271 ea., RFP 33-604-58-1617, $106,503.

Vacuum Tube Products Co., Inc., Oceanside, Calif., tube, electron, transmitting thyratron grid control rectifying, type 6278 in a/w spec. MIL-E-1C dated Oct. 3, 1955, and 188 MIL-E-1/818B dated June 28, 1956, 5,200 ea., IFB 33-604-58-352, $96,980.

HEADQUARTERS, ROME AFD, USAF, Griffiss AFB, N. Y.

General Cable Corp., Rome, N. Y., RG-17 A/U coaxial cable, (IFB 30-1635-58-157B), 280,500 ft., $80,223.

HEADQUARTERS, 3,600th COMBAT CREW TRAINING WING (FIGHTER), USAF, Luke AFB, Ariz.

John H. Evans & Co., Phoenix, Ariz., construction of special weapons range No. 5 at Gila Bend Auxiliary AFB, Gila Bend, Ariz., (IFB 02-604-58-26), $138,275.

MEMPHIS AFD, MALLORY AFS, 3300 Jackson Ave., Memphis, Tenn.

Continental Motors Corp., Muskegon, Mich., services, (call numbers 40-604-58-1 to AF 01(600)-20027 and 40-604-58-2 to AF 01(600)-20027), $31,000 and $35,000 respectively.

Marlin-Rockwell Corp., Jamestown, N. Y., bearings, (IFB 40-604-58-1905), $28,000.

Vickers Inc., Division, Sperry Rand Corp., Detroit, Mich., bearings, (IFB 40-604-58-1881), $28,500.

SKF Industries, Inc., Philadelphia, bearings, (IFB 40-604-58-1870), $186,285.

Wright-Aeronautical Division, Curtiss-Wright Corp., Woodridge, N. J., bearings, (IFB 40-604-58-1820), $309,700.

Bower Roller Bearing Division, Federal-Mogul-Bower Bearings, Inc., Detroit, bearings, (IFB 40-604-58-1914), $52,415.

Electronic engineers

NAA-Columbus, Prime Contractor to the Military for Advanced Weapon Systems, both aircraft and missiles, has career positions available in these fields:

ECM: analysis and development of airborne systems ECM.

RADAR: system development of Pulse-Doppler, C-W, and pulsed radars.

RECONNAISSANCE: study systems for effective use of IR mapping, ground mapping radar, and signal processing methods.

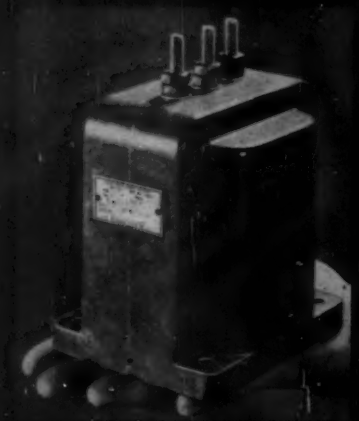
Qualified specialists are also needed for other related electronic work in our expanding groups. Please write:

Engineering Personnel
North American Aviation, Inc.
4300 East Fifth Avenue, Columbus, Ohio

NAA-Columbus, home of the T2J jet trainer and the A3J Attack Weapon System.

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.

. . . new lightweight aircraft transformers withstand extreme shock and vibration



A line of rugged, lightweight transformers specifically designed for high-acceleration, high-shock applications has been developed by Westinghouse Electric Corporation.

High resistance to extremes of pressure, vibration and shock makes these transformers ideal for many applications in both piston-powered and jet aircraft, as well as in high-thrust applications encountered just above missile-launching pads. Fitted with form-fit cases, these new transformers have no resonant points to well above 500-cycles vibration and are shock-tested at 50 gravities. They are completely insensitive to very high differentials of internal or external pressure.

Now in production at the Westinghouse Greenville Plant, these new transformers are available in ratings from 10 va through 5 kva, single-phase or three-phase, 400-cycles, 2500-volt test.

Contact your nearest Westinghouse representative for complete information on how this small, rugged unit can help solve your aircraft or missile transformer problem . . . or write Specialty Transformer Department, Westinghouse Electric Corporation, P.O. Box 231, Greenville, Pa.

J-70879

YOU CAN BE SURE... IF IT'S Westinghouse

Ramjets Power Netherlands Helicopter

Design for simplicity, low cost and ease of operation are key points in new H-3 Kolibrie ramjet-powered helicopter, which recently received a certificate of airworthiness, based on U.S. requirements, from the Netherlands Department of Civil Aviation.

Netherlands Helicopter Industry has started deliveries of the small helicopter to the Dutch government and is working on a further production lot of 10 to be completed this summer. Wings of Israel, Tel Aviv, placed the first foreign order for H-3s and is expecting delivery this summer.

H-3 Specifications

Specifications show that the H-3 has a minimum empty weight of 530 lb. and can carry a pilot, fuel, equipment and payload totaling 904 lb. in its civilian version. Powerplants are two NHI-designed ramjets weighing 20 lb. each dry and providing 60 ehp. each.

Military version has a minimum empty weight of 530 lb. and grosses out at 1,540 lb. During demonstrations of its air-ambulance capability, the H-3 has carried four persons, including pilot.

Choice of ramjet propulsion cut some two-thirds of the prime cost of the helicopter compared to conventional piston engines of the same power rating, Netherlands Helicopter Industry notes. Engines, developed in collaboration with Netherlands National Research Institute, consist of a "flat" shell containing fuel jets, baffles and low-tension igniter and burn household-grade kerosene. Each powerplant is connected to its main rotor tip by two bolts; fuel line and ignition circuit are quick disconnects. Fuel supply simply uses centrifugal force. Fuel systems are separate for each engine.

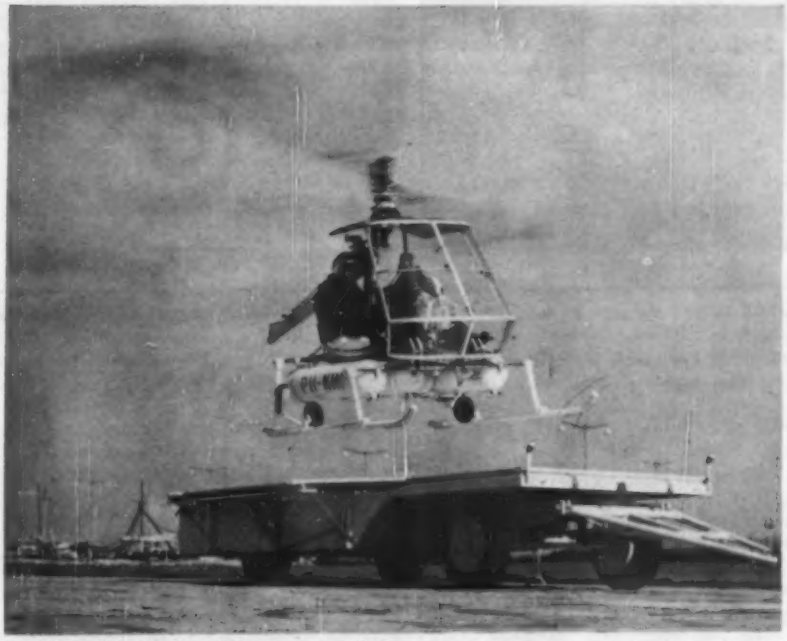
Starting Engine

A two-horsepower starting engine can be either built-in on the rear of the rotor pylon or used as separate ground-operated equipment. When fitted to the helicopter the engine weighs 15 lb. When separate, it is connected to the rotor using a flexible shaft and controlled by handlebars.

Rotor system is designed to permit hands-off stability. Blades are planned so that the center of gravity is ahead of the center of lift so that air loads tend to reduce angle of attack. Blades utilize modified National Advisory Committee for Aeronautics 0012 section. See-saw type blade hinges reduce number of parts; the two blades are connected by a pack of leaf springs replacing conventional torsion bearings and flapping hinges. Rigid tube between the blade roots acts as a droop stop and provides a fulcrum about which blade incidence is changed.

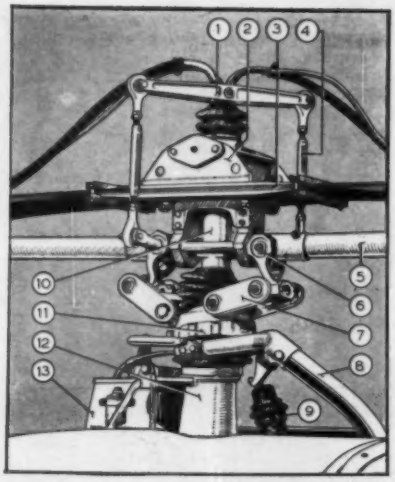
Blades are of bonded light alloy makeup and are oversize to provide extra ruggedness; they are some four times heavier than rotors on the same-size class conventional helicopters, permitting overloads in the neighborhood of 300%. Range of usable rpm. has been increased from 10% to 50%, Netherlands Helicopter Industry reports.

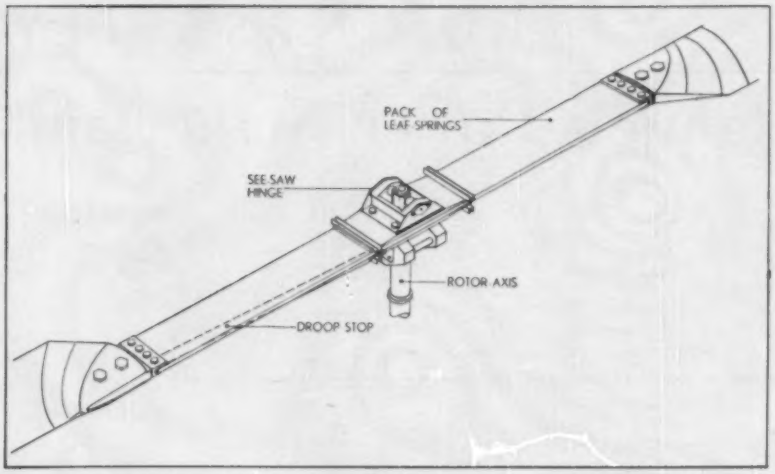
High rpm. and blade weight provides a large amount of kinetic energy to give maximum climb performance—H-3 can



NETHERLANDS Helicopter Industry H-3 helicopter carrying two persons lands on a special Helicar trailer. Side flaps on trailer are hinged to permit extension of landing area.

PRINCE Bernhard of the Netherlands inspects one of the 60 ehp. ramjet engines at tip of H-3's main rotor. Engines burn household-grade kerosene. Fuel is fed by centrifugal force.





ROTOR SHAFT and control details (left) include: 1—collective pitch control yoke; 2—rotor hub; 3—blade retention straps; 4—push-pull rod; 5—blade control tube; 6—cyclic pitch control yoke; 7—scissors link; 8—cyclic pitch control stick; 9—cyclic pitch control trim; 10—main rotor shaft; 11—wobble plate; 12—main rotor shaft bearing housing; 13—rotor mast. Torsion bearings and flapping hinges are eliminated in main rotor (right) through use of see-saw hinge and leaf springs. Maintenance required is reported to be negligible.

climb at 2,000 fpm. for short intervals, pilots report.

Large margin of energy also provides rapid phaseover to autorotation and, should one engine quit, energy aids single-engine operation.

Tail rotor is used only for directional control; Netherlands Helicopter Industry notes that the H-3 has been flown at full throttle with the tail rotor stopped.

Tail rotor has a single dynamically balanced blade.

Landing gear is conventional twin-skid type; floats are also available. Ski gear is also proposed for operations on muddy terrain. For agricultural duties the H-3 can be fitted with two 25-ft. spray booms capable of laying down a 66-ft. wide swath. Netherlands Helicopter Industry estimates that the helicopter can cover an average of 75 acres/hr. with cost varying between 57 cents and one dollar per acre depending upon annual utilization.

Company has designed a special ground trailer for the H-3, which also provides a mobile platform for takeoffs and landings.

Netherlands Helicopter Industry's production program splits components manufacture among several firms:

- **Airframe** is made by an associate company, Aviolanda.
- **Ramjet engines** and rotor hub are manufactured by another associate firm, Kromhout Engine Works.
- **Rotor blades** are built by Fokker.

Netherlands Helicopter Industry, N.V., was founded in 1955. Its offices and development are based at Rotterdam Airport.

Netherlands Helicopter Industry H-3

Powerplant	2 NHI TJ-5 ramjets at 60 eshp. ea.
Main rotor diameter	33 ft.
Length	13 ft. 10.5 in.
Height	8 ft. 5 in.
Landing skid track	6 ft. 3 in.
Tail rotor diameter	2 ft. 9 in.
Maximum speed	70 mph.
Maximum cruise speed	60 mph.
Rate of climb at 30 mph.	1,200 fpm.
Rate of descent on one engine	2,000 fpm.
Endurance (pilot only)	1 hr.
Range (pilot only)	60 mi.
Total tankage (fuel and/or chemicals)	26.4 gal.

	Civil	Military
Minimum empty weight	530 lb.	530 lb.
Gross weight	904 lb.	1,014 lb.

U.S. Parachutists Seek Championship

Eliminations to decide makeup of a five-man team representing the United States at the Fourth World Parachuting Championship to be held this summer in Czechoslovakia will be June 15-25 at Vancouver, B. C. Fifty American parachutists, selected principally from clubs associated with the Parachute Club of America, will compete in a three-part series of drops.

First drop will have all 50 participants make three jumps at 7,000 ft. In two of these, each contestant will free-fall for 27-33 sec., open his chute and attempt to land on a target. Judging will be on basis of accuracy and style. Third jump will require the parachutist to perform a figure eight, a horizontal turn to the left and one to the right, while falling.

Top 20 men of this event will go to the second round, based on the first three events of the world championship requirements.

Top 10 of this round will be a repeat of the second elimination. Top members of this final contest will make up the U.S. team going abroad for the meet being held in Bratislavia on Dvorniky airfield Aug. 1-16. Bulgaria, Czechoslovakia, France, Hungary, Poland, Rumania, U.S.S.R. and Yugoslavia already have made commitments to participate.

Biggest handicap facing the American team is lack of funds to pay for traveling expenses and necessary equipment. Parachute Club of America is currently campaigning for donations, requesting that checks be made out to the National Aeronautic Association Parachute Fund, 1025 Connecticut

Ave., N.W., Washington 6, D. C. Event is sanctioned by the Federation Aeronautique Internationale.

The 1956 U.S. parachuting team managed to borrow a lightplane for practice prior to the event, collected barely sufficient funds to get to Mossow for the Third World Parachuting Championship, in which 10 nations participated. Nonetheless, the U.S. team managed to surpass four of the better-financed foreign teams.

Lightweight Plumbing Goes Into Commander

Aeroquip technicians have designed and installed a fireproof long-life plumbing system on the company's 680-S Aero Commander.

Modification, which includes changing lines in the plane's fuel, oil and hydraulic systems, involves a weight penalty of only a pound per nacelle. Similar modification, excluding asbestos fire sleeves forward of the fire wall, results in a weight saving of 3 lb. 8 oz. per nacelle for a total weight reduction of 7 lb. per plane, a plumbing weight saving of some 21%.

Either new configuration results in tripling the plumbing's service life, according to Aeroquip.

Changeover to the new plumbing involves: replacing all original Aeroquip 303 fuel and oil lines with Aeroquip 601 lightweight hose assemblies. In addition, all assemblies forward of the firewall may be protected with Aeroquip 624 asbestos fire sleeves, which, according to the company, "results in a fireproof installation as defined by Civil Aeronautics Administration. . . ."

PRIVATE LINES

U. S. Army awarded Beech Aircraft Corp. a $3 million contract for L-23D Seminole (Twin-Bonanza) aircraft, extending production through March 1959. . . . Firm sold F50 Twin-Bonanza executive transport to Jordan army for use by King Hussein. Extra tanks, to provide 330-gal. fuel capacity, were temporarily fitted for overseas flight delivery via Newfoundland, Azores and Madrid.

Taylorcraft, Inc., is moving from Conway, Pa., to Connellsville, Pa., 37 mi. southeast of Pittsburgh, into a facility having total of 89,500 sq. ft. of floor space including 41,615 sq. ft. of manufacturing area.

More than 125 private flyers have signed as members in recently organized Grand Bahama Flying Club, open to pilots who have made at least one flight across the 65-mi. water gap between the club and Florida. Club is aiming to increase membership to 500 by spring of 1959 and to organize its first mass fly-in and annual meeting. Current plans include a July 12 group fly-in for Florida Aero Club members and participation in Ninth All Women's International Air Race scheduled to start Aug. 17 from Wellend, Ontario, and terminating at West End, Grand Bahama.

New Gen. William J. Fox Airfield in Antelope Valley, Calif., is expected to be operating in November. Plans call for a 6,000-ft.-long, 150-ft.-wide asphalt runway. Cost of first-phase construction is estimated at $1,162,030 with approximately 54% paid for by Civil Aeronautics Administration.

Instrument rating study guide, prepared by Civil Aeronautics Administration, recommends basic study material, contains sample examination with questions and answers, sample instrument approach chart, low/medium frequency and very high frequency radio facility chart, excerpts from Airman's Guide and an aeronautical chart. Sample examination is of the new cross-country type and is based on a simulated flight from St. Louis, Mo., to Omaha, Neb. Instrument Pilot Examination Guide is available for 65

Cb ...and You

Cb (Columbium) is a rare element. Some engineers are rare elements, too. You may design combustors — evaluate testing data — improve operations methods. In any work, your "rare element" quality — insatiable curiosity — restless imagination — eager skepticism — puts you a creative notch above your colleagues. This quality varies with the individual, but it makes you the rare element engineer we look for — the rare element engineer these positions require.

AERO-THERMODYNAMICS

(1) Complete aerodynamic design responsibility for development and experimental engine turbines and compressors; contribute new design approaches, product improvement methods. — M. E. or A. E.; courses in fluid dynamics, thermodynamics; 4-5 yrs. aerodynamic turbine design experience. Other gas turbine experience considered.

(2) Develop parameters, performance characteristics for successful operation of engine components; provide aerothermodynamic design information for static and rotating parts, sub-components. — M. E. or A. E.; good knowledge aero-thermodynamics; 1-3 yrs. gas turbine experience.

MECHANICAL DESIGN

(1) Establish and utilize design practices in mechanical engineering analysis; provide advance techniques for solving critical problems related to static and rotating parts. — B.S. or M.S. in mechanical engineering or related field, 4-5 yrs. aircraft gas turbine experience.

(2) Create and analyze aircraft gas turbine component designs. — Technical engineering degree; 1-3 yrs. gas turbine experience.

These positions demand your rare element. Write us in confidence.

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Large capacity... easily programmed and operated... mobile... low in cost

No more waiting in line for those answers you need! No more lost time in reducing valuable data from flight test, wind tunnel, missile development! Not with the Royal Precision LGP-30. Compact, completely mobile ... LGP-30 will today furnish you with high-speed electronic computation *wherever you want it.* And at the lowest cost ever for a complete computer system!

Unusual capacity. Operating from a standard wall outlet, performing an almost unlimited range of calculations, the self-cooled LGP-30 allows you to work your problems *at the site or at your desk* ... gives you the flexibility of stored-program operation combined with speed, memory (4096 words) and capacity comparable to equipment many times its size and cost.

Easy to operate and program. LGP-30's controls are so simplified, even non-technical personnel are quickly trained. Programming, too, is easily learned. A library of sub-routines, plus programs for a wide variety of avionics applications, is available.

Wide scope of aircraft applications. In addition to flight test, wind tunnel and other data reduction jobs, LGP-30 is currently being used in a great variety of aircraft applications, among them vibration and flutter analyses, thermal stress distribution, wave drag calculations, problems of transient heating, propulsion research problems, lofting, operational and flight test trajectory studies, surface and air missile launch problems.

Exceptional value; complete service. Smallest initial investment ever for a complete computer system is combined with low operating and maintenance costs. Coast-to-coast service facilities.

For further information and specifications, write Royal McBee Corporation, Data Processing Division, Port Chester, N. Y.

ROYAL McBEE

WORLD'S LARGEST MANUFACTURER OF TYPEWRITERS AND MAKERS OF DATA PROCESSING EQUIPMENT

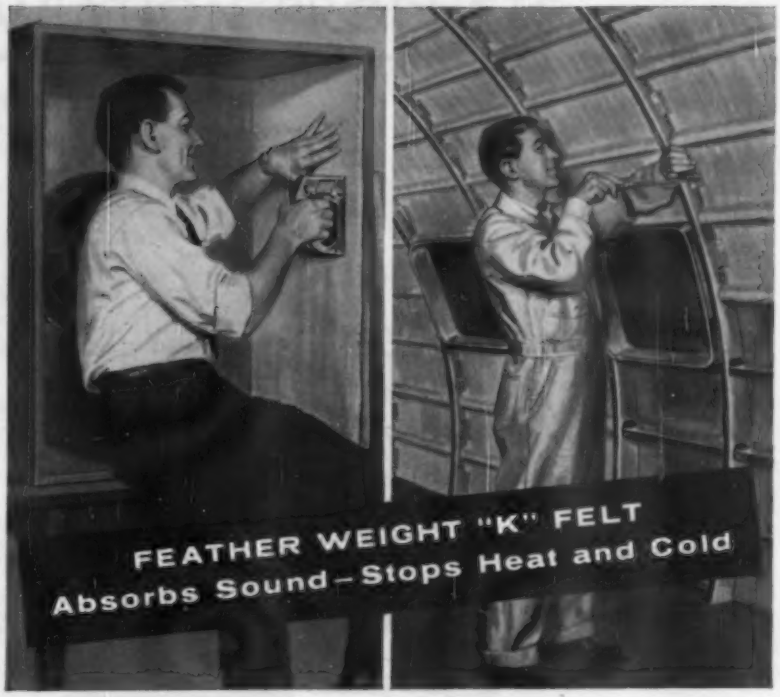
DeLackner Vehicle

This configuration of one-man DeLackner helicopter is fitted with a skid-type landing gear in place of inflated rubberized doughnuts on flattened tripod used on early models built for U. S. Army. A 40-hp. Mercury Mk. 55 outboard motor turns two contra-rotating rotors under the pilot's feet.

cents from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

New VHF-FM Flightcom two-way radio is completely interchangeable between aircraft 12 and 24-v. battery systems, weighs 21 lb. complete including ATR-type shock mount, control box with cables and microphone. Transmitter has power output 35 watts in 25-54 m.c. band and 25 watts in 144-174 m.c. band; low-band model is priced at $585, high-band version at $600. Dual frequency operation adds $30 to these prices. Units are available from Communications Co., Inc., 300 Greco Ave., Coral Gables, Fla.

Business and utility plane exports by five manufacturers in January totaled 67 units with airframe weight of 6,000 lb. or less valued at $947,899. This was a decline of 27% in dollar value compared to the same period last year. January 1957 exports in units totaled 85 planes. Belgium was leading importer of U.S. aircraft last January, taking three planes valued at $153,000; next were Venezuela with total purchases of $132,000 and Union of South Africa with $112,000.



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American's "K" Felt is a unique engineering material... a *combination* thermal barrier *and* sound absorber!

"K" Felt eliminates unwanted resonance, reverberation and accoustical feedback... when you line the inside of your speaker enclosures, TV cabinets, turntable compartments and body panels with this easy to apply material.

In large-area work, such as aircraft cabins, sound and TV studios, you benefit from "K" Felt's feather weight ... which substantially adds to your payload! These resilient Felts are moth-proof, mildew-proof, non-dusting and flame-resistant. They withstand *violent* vibration and temperature changes *without* deterioration... and are safely handled *without* special tools or protective clothing. Manufactured in 72" wide rolls – thickness from ⅛" to ½" – "K" Felts are approved under all applicable Government specifications.

Learn more about versatile, highly efficient "K" Felts and how they can help you. Write, on company letterhead, for Data Sheet #3 which includes information about "K" Felts K-factors, noise reduction coefficients and densities.

Remember: American Felt Company has the most extensive and best equipped staff of product engineers in the Felt industry... with *engineered* materials for seals, wicks, insulation, decoration, vibration mounts, polishing and filtration.

General Offices and Engineering and Research Laboratories
104 Glenville Road, Glenville, Connecticut

American Felt Company
TRADE MARK

THE MAN BEHIND THE GREASEGUN... The exploits of the fliers and aircraft that are keeping our nation secure can not be written without proper credit to the unheralded man behind the greasegun. He is a member of a maintenance crew... a crew chief... a plane captain who is content to enjoy the reflected glory of his ship. Something of him flies with every aircraft, and when ship and crew return safely he knows his job has been well done. For he knows that nothing could fly, no pilot could climb aboard without his contribution. Kaman Aircraft recognizes the job these men are doing and gives them a tangible salute by designing helicopters which require minimum maintenance and make the man behind the greasegun whistle while he works.

THE *KAMAN* AIRCRAFT CORPORATION

PIONEERS IN TURBINE POWERED HELICOPTERS

BLOOMFIELD, CONNECTICUT

NEW AVIATION PRODUCTS

Jet Engine Warning System

Warning system detects torching on jet engine burner cans, or informs pilot of successful afterburner light-off.

Thermostat, operating on principle of unequal expansion of two metals, provides electrical output signals to detect temperature overshoots to beyond 2,000F in main turbines. Manufacturer

states that electrical portions of the system operate at ambient temperatures of 1,000F, and operating time is .1 sec.

AiResearch Manufacturing Division, Garrett Corp., 402 S. 36th St., Phoenix, Ariz.

Altitude-Temperature Test

Altitude temperature combination test system that can be converted into independent altitude and temperature test units has been developed. Model AT100-27 has a 27 ft. altitude chamber which nests in a 53 ft. temperature chamber. Units can be separated and operated independently or simultaneously. Altitude range is up to 200,000 ft., temperature range is from −100F to +400F. Heating system is electrical, coolant is dry ice or liquid 2.

Mantec, Inc., 126 Maryland St., El Segundo, Calif.

Structural Inspection Kit

Inspection kit provides method of checking bond of honeycomb structures in aviation uses and other applications. Method is said to be most effective on metallic honeycomb, soldered, welded or brazed skin surfaces.

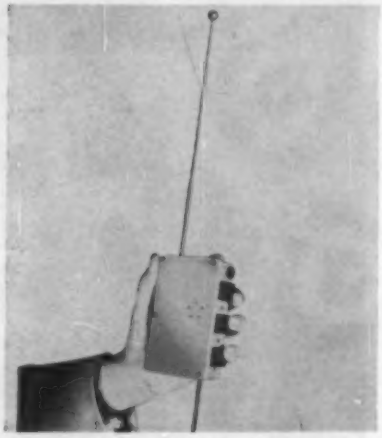
Bondcheck BC-1 inspection kit contains specially formulated red fluid that is repelled by heat and tends to flow to the coolest area on a metal surface. Sprayed on a clean surface and subjected to heat from an infrared lamp, the fluid accumulates on the coolest areas. Since heat is conducted from the surface to the honeycomb core at the areas of good bond, the fluid reproduces the exact pattern of the honeycomb core. Areas of defective bond are visible as gaps in this pattern.

Bondcheck kit contains an inspection stand, spray gun, 25 ft. of air hose, air pressure valve, air gage, 1 qt. Bondcheck fluid and two 12 oz. spray cans of cleaner. Powerstat operates on 110 v., 60 cycle, 1 ph. current drawing 15 amp.

Magnaflux Corp., 73000 W. Lawrence Ave., Chicago 31, Ill.

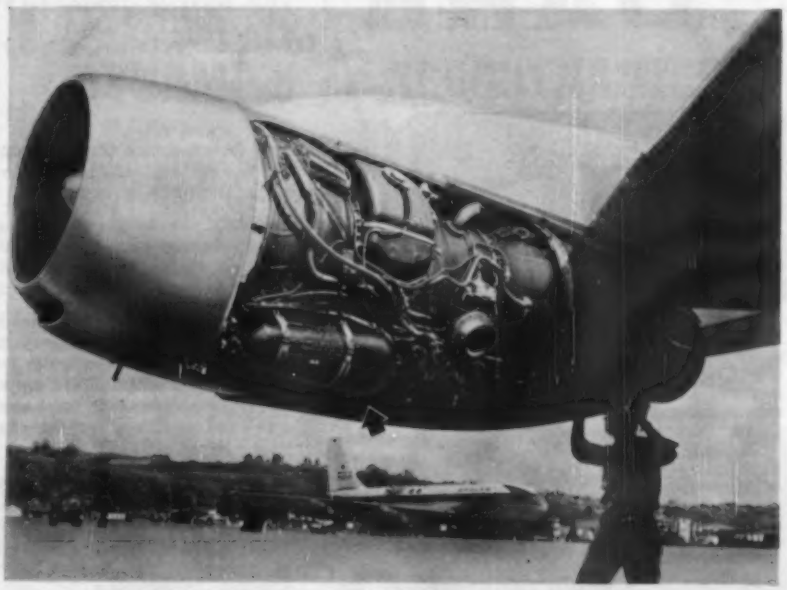
Emergency Radio Transceiver

Radio transceiver provides emergency communications link between downed fliers and rescue groups. Transceiver allows two-way radio communication,



emits a continuous tone-molulated carrier signal for homing purposes.

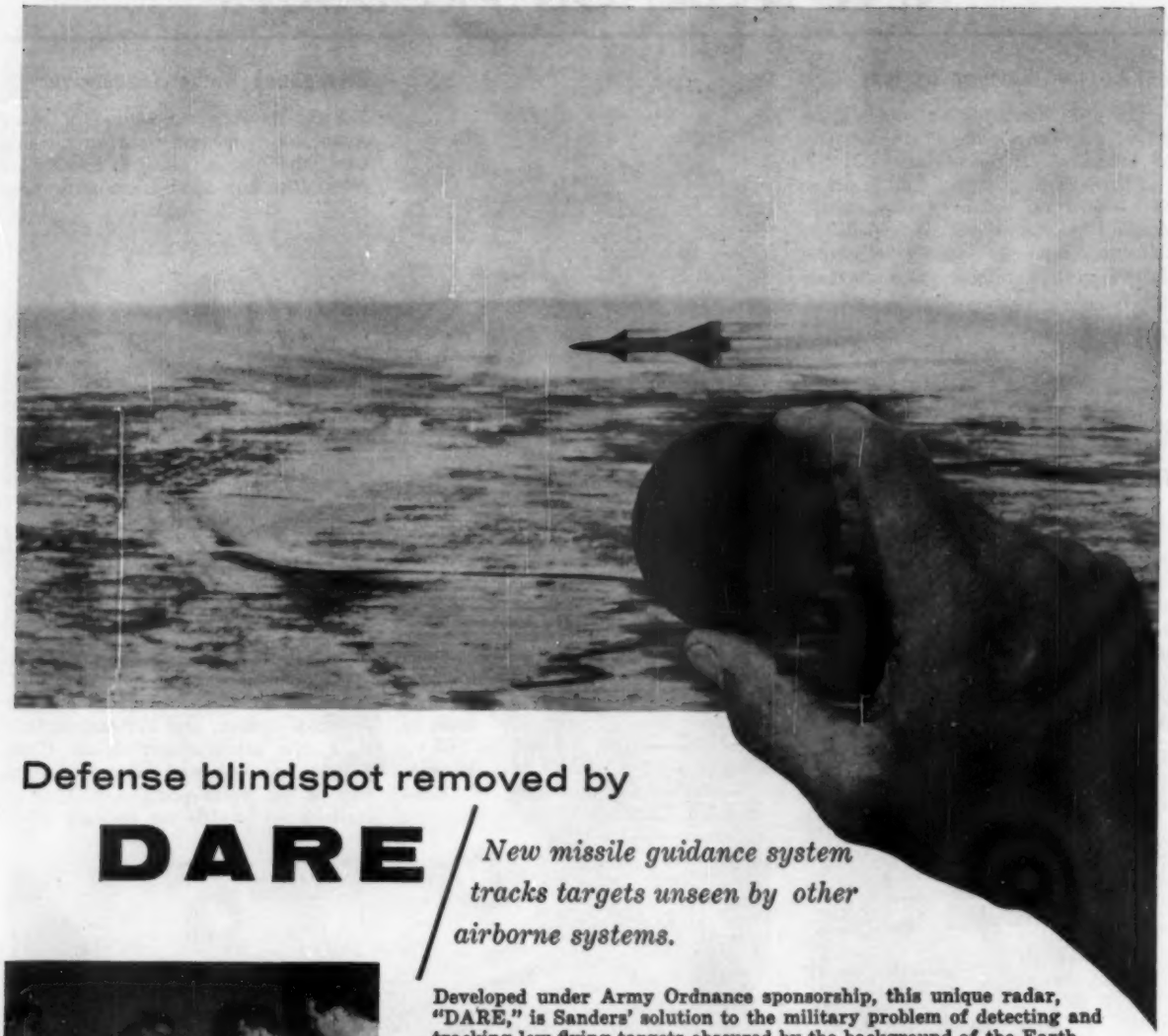
Model 5735 has range of 10 mi. surface-to-surface, and 100 mi. surface-to-air, the manufacturer claims. Combination microphone-headset is integral part of the water proof case. Unit is available in models for military UHF



Starter Air Bottle for KC-135

This 3,000 psi. metal air bottle (arrow) is installed in number four engine nacelle of Boeing's jet-powered KC-135 tankers to supply air for engine's fuel-air starter system. Air to start other three engines is bled from operating powerplants. Tapered shape of the welded assembly was dictated by installation requirements. Container is 35 in. long, has a maximum diameter of 13¼ in., a capacity of 2,950 in. and weighs 84 lb. Unit meets gunfire resistance per MIL-C-7905. Manufacturer is Walter Kidde & Company, Inc.

Another example of SYSTEMS CAPABILITY *at Sanders Associates*



Defense blindspot removed by

DARE

New missile guidance system tracks targets unseen by other airborne systems.

SANDERS' "DARE" TEAM was headed by William Morgan, Coherent Ground System; Kenneth Dollinger, System Project Engineer; Alfred Cann, Missile Seeker; Robert Stetson, High Voltage and Microwave Circuits.

500,000 SQUARE FEET OF FLOOR SPACE give Sanders Associates ample room for expanded research, development and production of electronic, electromechanical and hydraulic components, sub-assemblies and systems . . . in interchangeable modular designs or subminiature packages.

Developed under Army Ordnance sponsorship, this unique radar, "DARE," is Sanders' solution to the military problem of detecting and tracking low-flying targets obscured by the background of the Earth.

DARE exploits Sanders' capabilities in both systems and components. The same personnel who speeded this system through study and demonstration stages have contributed successive significant "breakthroughs" in missile and radar developments since 1945.

Design and production of key missile components has enhanced and assured success of the DARE project. Sanders Associates is a well-known creator and producer of *hydraulic servos* for steering and controlling missiles and antennas . . . *rate gyros* for stabilization and control . . . *microwave components* for antenna and RF circuitry . . . *flexible printed circuitry* for decreasing size and weight and increasing system reliability.

Systems capability at Sanders extends in many directions. Research, development and production experience and facilities are geared to accelerated progress in anti-submarine warfare, fire control, electronic countermeasures, autopilot and industrial automation systems. Sanders Associates can find answers to your systems problems, too.

SANDERS ASSOCIATES, INC.

NASHUA, NEW HAMPSHIRE • *Inglewood, California* • *Washington, D.C.*

band or civil HF distress frequency. Transceiver weighs 1¼ lb. Mercury battery, weighing 3 lb., operates unit for 15 hr. on 10-min. receive, 5-min. transmit cycle.

Production Research Corp., Thornwood, Calif.

Sidewall-Inflated Aircraft Tire

Tubeless aircraft tire is fitted with a rubber inflation valve on sidewall. Inflation needle, similar in design to needle used to inflate a football, is used to fill tire with air, eliminating rim valve.

Tire shown is being tested on Chance

Vought F8U-1 fighter. Tire has completed dynamometer tests and after completion of tests with F8U will undergo trials with other military aircraft. Maker states tires have withstood test inflation of 385 psi. Tire sizes range from 20x4.4 up to 17.00-20.

Goodyear Tire and Rubber Co., 1144 E. Market St., Akron 16, Ohio.

Helicopter Boost Cylinder

Power boost cylinder for helicopter main and tail rotor pitch control and throttle control has integral valve and shaft design. This provides over-ride for emergency power-off operation and

a compact package for ease of installation and maintenance.

Customer has choice of valve gain curve, low valve force, stroke, porting and mounting. Not sold as shelf item.

Conair, Inc., 731 W. Wilson Ave., Glendale, Calif.

High G-Force Camera

Fastair camera takes high speed motion pictures while undergoing high G loads in test work involving missiles and aircraft.

Photo shows four Fastair cameras mounted on F-104 downward ejection seat that has been inverted for rocket sled test. Camera weighs 8½ lb., measures 4 x 5 x 14 in. and can operate during acceleration and deceleration of 100Gs, the manufacturer states. They operate from 12 to 600 frames per sec., have a timing light, timing light generator and heater for low temperature operation. Camera has interchangeable lenses, flat speed characteristic curve, is capable of "stop start" operation, accepts standard daylight loading spools.

Wollensak Optical Co., 850 Hudson St., Rochester 21, N. Y.

Fuel Gage Tester

Fuel gage tester is designed to calibrate and test aircraft capacitance type fuel gages in the field or at maintenance depots.

MD-1 tester is a self-contained unit

Do you have enough experience in

DYNAMICS or AERODYNAMICS

to work in our

ADVANCED SPACE FLIGHT PROGRAM

We are one of the West Coast's largest, most experienced missile manufacturers. We are now engaged in a program that involves far-advanced problems in Space flight.

This means top-level openings for dynamicists and aerodynamicists. By *top-level* we mean not only top *responsibility*, but top *money* and *benefits* too.

DYNAMICS ENGINEER

BS, MS, or PhD in Aeronautical Engineering, Mathematics, or Physics. Three to six years experience in aerodynamics, flight dynamics, and dynamics.

Conduct analytical and analog studies leading to control system requirements, and to dynamic characteristics of new missile proposals.

AERODYNAMICS ENGINEER

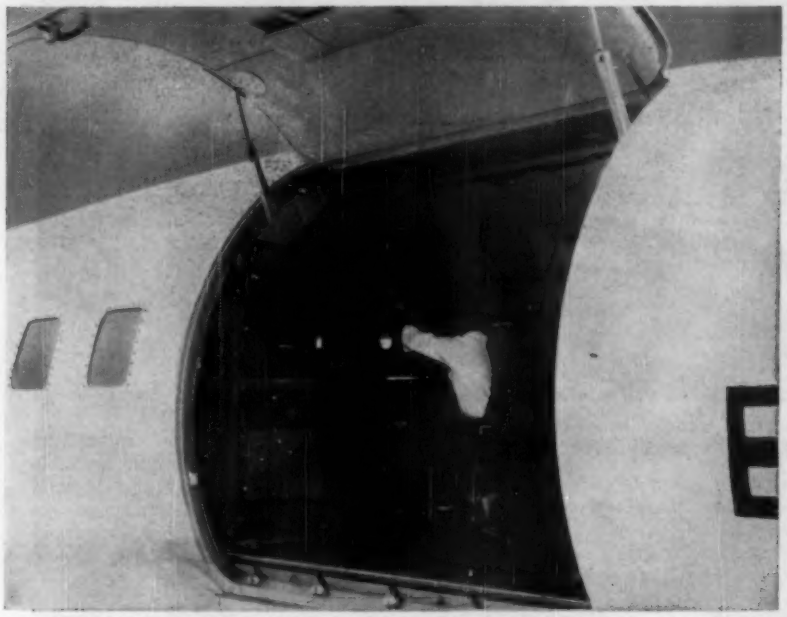
BS, MS, or PhD in Aeronautical Engineering—or in Mechanical Engineering with Aero option. Two to six years experience in aeronautical performance, or in stability and control.

Work on analytical missile configuration to determine aerodynamics performance, and stability and control characteristics. Also to do advanced study of aerodynamics implications to new designs.

Please send complete resume to:

P-7724, Aviation Week
68 Post St., San Francisco 4, Calif.

ENGINEER OPPORTUNITIES AT RAYTHEON



DOPPLER NAVIGATION EQUIPMENT is readied for flight testing under operational conditions. Engineers at the Maynard Laboratory hold responsibility for program from initial study phase through prototype production.

Newly formed project groups solve complex airborne radar problems

Engineers like the project-type organization at Raytheon's Maynard Laboratory. It gives them maximum diversification in their work on the most advanced radar navigational and control problems of the day.

At Maynard, you'll find projects involving many areas of aircraft navigation and guidance systems . . . doppler navigation, velocity check systems, night-fighter operations systems, flight-control systems, altimeters. There is also interesting new work on countermeasures equipment.

Career opportunities for men at all levels now exist in the following areas:

MICROWAVE COMPONENT DESIGN
ANTENNA DESIGN
ELECTRONIC PACKAGING
SYSTEMS ANALYSIS & ENGINEERING
TECHNICAL WRITING
SPECIFICATIONS WRITING
ADVANCED CIRCUIT DESIGN

For complete details on engineering positions in any of Maynard's project groups, please write John J. Oliver, P.O. Box 87A, Raytheon Maynard Laboratory, Maynard, Mass.

RAYTHEON MANUFACTURING COMPANY
Maynard, Massachusetts

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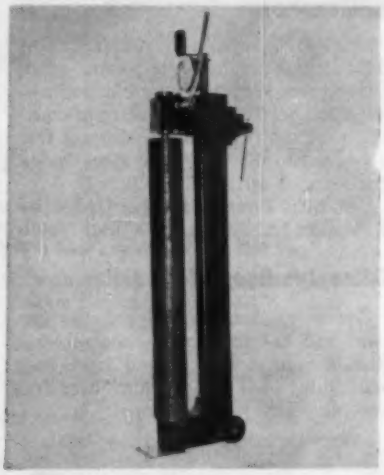
requiring no outside power source. It has a direct reading, precisely variable capacitor with a range of from 10 to 6,200 micro-micro farads. Through use of a main and vernier dial, technicians can read capacitance values in increments of 0.1 uuf. Maker claims unit is accurate to 0.1%.

Unit comes equipped with nine accessory cables for connection to all types of capacitance gages. Tester is said to withstand weather and meets Air Force specification Mil-T-8579.

Telectro Industries Corp., 35-16 37th St., Long Island City 1, N. Y.



Portable Hardness Tester

Portable Brinell hardness tester is designed for cylinders, die blocks, and large castings. Unit's 45 lb. weight permits use in places not accessible to standard hardness testers.

Tester has a capacity of 29 in. and a 3½ in. throat. Unit uses a 5mm. or 10mm. carbide ball with any load to 3000 Kg. It can be used in any position and is equipped with rollers for added mobility.

King Tester Corp., 440 N. 13th St., Philadelphia 23, Pa.

WHAT'S NEW

Reports Available:

Following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D.C.

Copolymers of 1, 1-Dihydroperfluorobutyl Acrylate with Some Vinyl Silanes—by E. C. Stump, Jr., Wright Air Development Center, U. S. Air Force. August, 1957. $.75; 24pp; (PB 131375).

Dilute Solution Techniques for Styrene-Methyl Methacrylate Graft Copolymer and Its Precursors—by R. A. Guzzi, Picatinny Arsenal, U.S. Army Ordnance Corps. April, 1957. $.50; 20pp.; (PB 131261).

A Study of the Thermal Decomposition of Methane—by F. W. Cagle, Jr., University of Utah for Air Force Office of Scientific Research. March, 1956. $.50; 12pp.; (PB 121450).

Environmental Requirements Guide for Electronic Parts—by Advisory Group on Electronic Parts, Office of the Assistant Secretary of Defense for Research & Engineering. October, 1957. $.50; 11pp.; (PB 131423).

Performance of Cooper-Mandrel Potentiometers in A-C Operational Amplifiers—by H. H. Hosenthien, Army Ballistic Missile Agency. September, 1956. $1; 35 pp.; (PB 131289).

Mock-Up Evaluation of MLO-8200 High-Temperature Hydraulic Fluid at 400F—by F. P. C. Paraskos and F. R. Straus, Wright Air Development Center, U.S. Air Force. February, 1955. $1.25; 41pp.; (PB 121957).

Hydrogen, Crack Initiation, and Delayed Failure in Steel—by H. H. Johnson, J. C. Morlet and A. R. Treiane, Case Institute of Technology for Wright Air Development Center, U.S. Air Force. May, 1957. $1.50; 52pp.; (PB 131340).

Titanium Production Developments Including Metallurgy and Alloying—by R. I. Jaffe, Titanium Metallurgical Laboratory, Battelle Memorial Institute for Office of Assistant Secretary of Defense for Research & Development. August, 1957. $2.75; 102pp.; (PB 121632).

The Bending Vibrations of a Twisted Rotating Beam—by W. P. Targoff, Cornell Aeronautical Laboratory, Inc., for

AERODYNAMICISTS & STRUCTURES ENGINEERS

Here are interesting openings on advanced VTOL Projects...

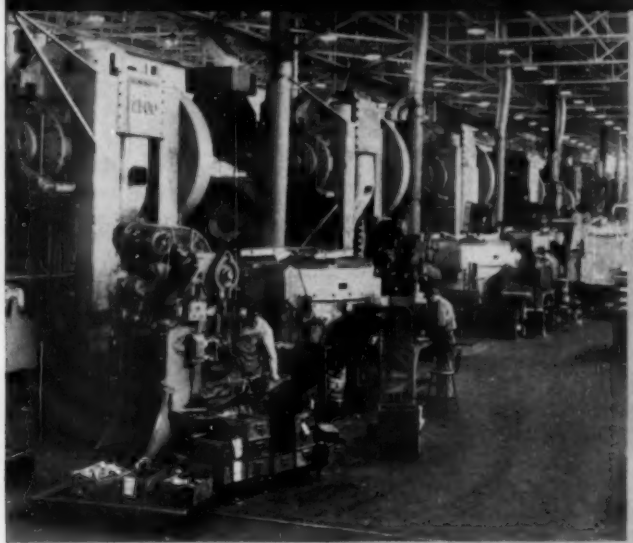
Bell Aircraft is making steady progress toward the development of high-performance, jet aircraft which will take off and land vertically in a conventional attitude. Two test vehicles, one of them the X-14, have been flown successfully.

Expansion of this VTOL program has created openings for experienced aerodynamicists and structures engineers with experience in these fields:

- Flutter and Vibration
- Flight Control Systems
- Propulsion Systems Design and Analysis
- Armament and Installation Layout
- Structural Design and Analysis

Here are challenging, long-range opportunities to participate in the production of the planes of tomorrow. Top drawer salaries and benefits with a world of room for rapid advancement. Please write: Supervisor of Engineering Employment, Dept. E-22, BELL AIRCRAFT CORPORATION, P. O. Box 1, Buffalo 5, N. Y.

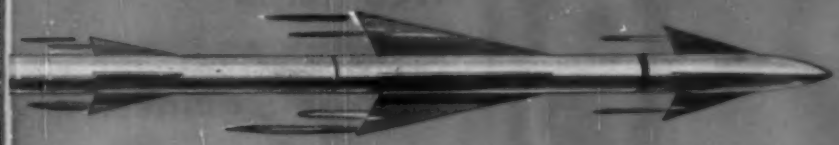
BELL Aircraft corp



Battery of forging presses up to 4000-ton capacity produces precision parts from unusual metals at the Jet Division.

Our experience includes the precision-forging of thousands of jet engine components, with tolerances as close as ± 0.003".

Write on your company letterhead for Booklet AW-458, which describes the facilities and capabilities of the Jet Division.



Precision forgings with 20-micro finish available for missiles from the Jet Division

Many parts for missile controls, power plants, and structures require the high strength of a forging. Yet complex contours and super-tough alloy structure may make finish-machining slow, costly, and sometimes almost impossible.

This is the place for precision forgings made by the Jet Division. Unusual techniques and precise dies permit production of forged parts with such accurate dimensions and contours that "finish machining" generally means merely a simple polishing operation. Surfaces with 20-micro finish are being produced regularly at the Jet Division.

Alloys now being forged at the Jet Division include stainless and high-alloy steels, Stellite and superalloys, as well as titanium and zirconium.

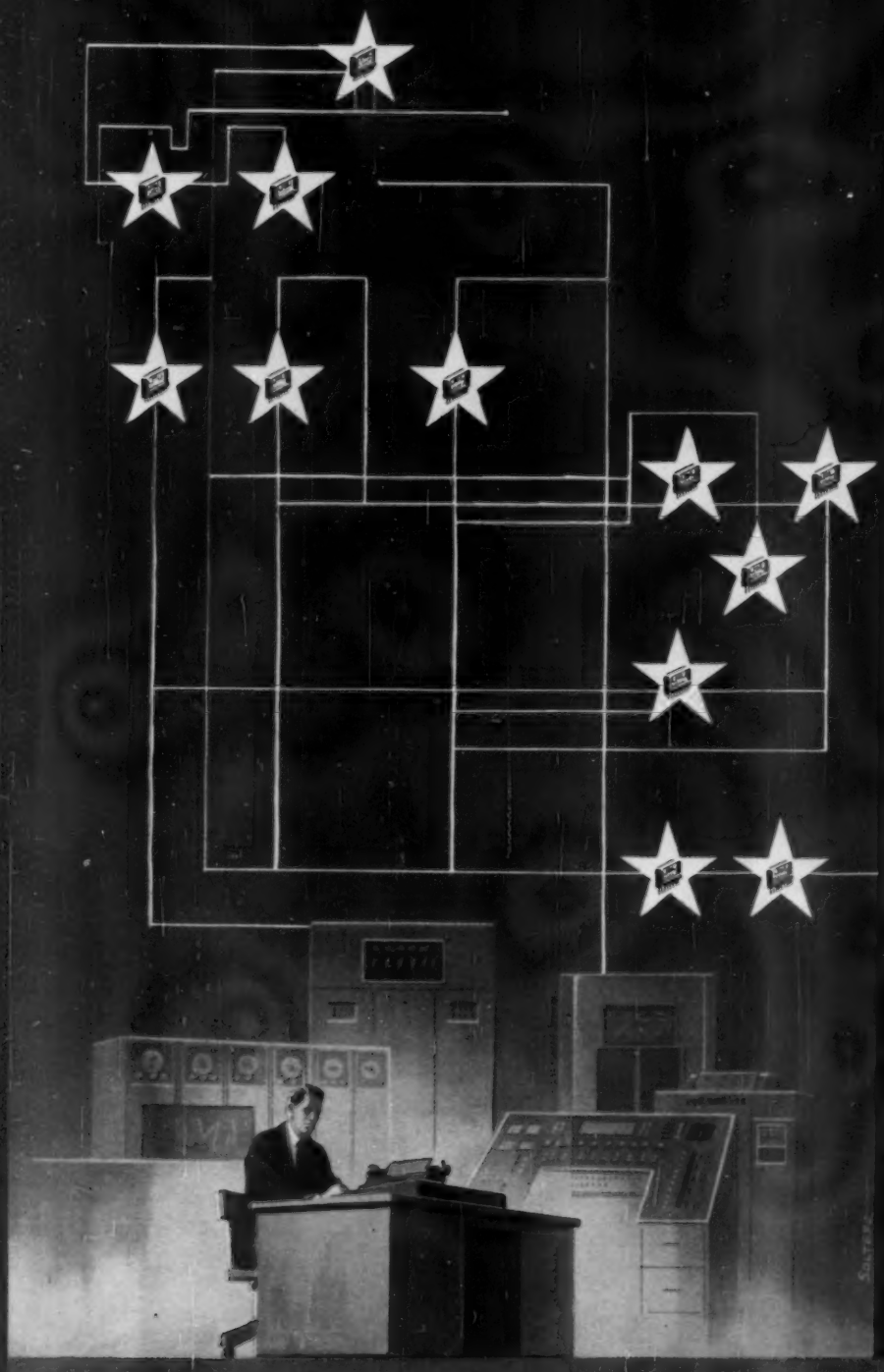
Our forging engineers will call at your convenience to discuss precision forging applications with your engineers and production men.

JET DIVISION

TP

Thompson Products, Inc.

CLEVELAND 17, OHIO



Avco helps to shrink an electronic giant

What's the giant?
Today's mammoth computer.
How is it shrunk?
From the inside, electronically!

Avco research has perfected electronic 'building blocks'—miniature plug-in units, not much larger than penny matchboxes. They replace many vacuum tubes and yards of intricate wiring. Incredibly rugged, they operate perfectly at arctic or tropical temperatures . . . without air conditioning.

And the smaller computer they make possible can be used in hundreds of new ways . . . in industry and for defense. Avco 'building blocks' are already in production for a U. S. Army-U. S. Air Force *portable* computer.

Full name: Transistorized Logical Building Blocks
From: Avco's Research and Advanced Development Division

Avco today — its products are integral parts of the American scene: in homes and industry, on farms, and for defense. Avco works to give America the most dependable equipment, the most advanced ideas and research.

Scientists and engineers interested in unusual opportunities for advancement can grow with Avco.

Avco makes things better for America

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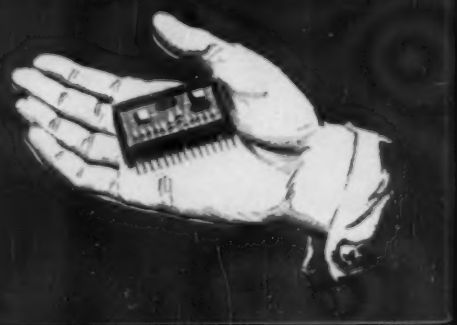

Wright Air Development Center, U.S. Air Force. August, 1956. $1.00; 33pp.; (PB 131234).

Uncoupled Torsional Vibrations of a Thin, Twisted, Rotating Beam—by W. G. Brady and W. P. Targoff, Cornell Aeronautical Laboratory, Inc., for Wright Air Development Center, U.S. Air Force. June, 1957. $1.00; 34pp.; (PB 131237)

Structural and Vibrational Characteristics of WADC S-2 Model Propeller Blades—by M. O. Burquest and J. E. Carpenter, Cornell Aeronautical Laboratory, Inc., for Wright Air Development Center, U.S. Air Force. June, 1957. $2.50; 98pp.; (PB 131370)

Evaluation of Designs and Materials for High Speed-High Temperature Shaft Seals for Turbojet Engine Applications—by E. J. Taschenberg and others, Koppers Co., Inc., for Wright Air Development Center, U.S. Air Force. May, 1956. $2.00; 73pp.; (PB 121992)

Factors Influencing Operating Limits of High Flux Axial Compressors—by F. L. Wattendorf, Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization, and H. Von Ohain and M. Lawson, Wright Air Development Center, U.S. Air Force. April, 1957. $.75; 75pp.; (PB 131388).

High Temperature Brittleness in Titanium Alloys—by N. Makrides and W. M. Baldwin, Jr., Case Institute of Technology for Wright Air Development Center, U. S. Air Force. June, 1957: $.75; 29pp.; (PB 131381).

Study of the Effects of Vacuum Melting on 550F Tempering Embrittlement—by M. Gensamer, Columbia University for Wright Air Development Center, U. S. Air Force. January, 1957: $1.25; 41pp.; (PB 131358).

Effects of Vibration on the Yield Strength of a Low-Carbon Steel—by G. E. Nevill, Jr., and F. R. Brotzen, the Rice Institute for Air Force Office of Scientific Research. April, 1957: $1.00; 31pp.; (PB 131260).

Tables of the Error Function and of Its First Twenty Derivatives—by Computation Laboratory, Harvard University, for U. S. Air Force. $2.50; 302 pp.; (PB 131464).

Soviet Bloc International Geophysical Year Information—reported in OTS series. The series run from Feb. 14, 1958, to Jan. 2, 1959. $10; (PB 131-632).

wanted:

an expression of interest!

General Electric's Jet Engine Dept., Cincinnati, Ohio, is now interviewing Engineers with 3 or more years experience in the following fields:

Mechanical Design	Aerodynamic Design
Control System Design	Control Component Design (Mechanical, Electrical, Electronic)
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Please check your field of interest above, fill out the coupon below, and mail entire ad to:

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Jet Engine Dept. AW-4-28
General Electric Co., Cincinnati 15, Ohio

This is *not* an application for employment; it is merely your expression of interest. Upon receipt of this coupon, we will forward a brief form to return to us describing your interests and experience. You may then be asked to visit Cincinnati, at our expense, to discuss with us, in as great a detail as you wish, your future with the Jet Engine Dept. of GE.

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- Opportunity to work with top engineers in a field in which you are most interested.
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- Opportunity to continue your education at either of two fine Universities under our 100% tuition refund plan.
- Sympathetic supervision that recognizes ability and rewards it.
- Security; we are a prime contractor with the government, with long-range contracts.

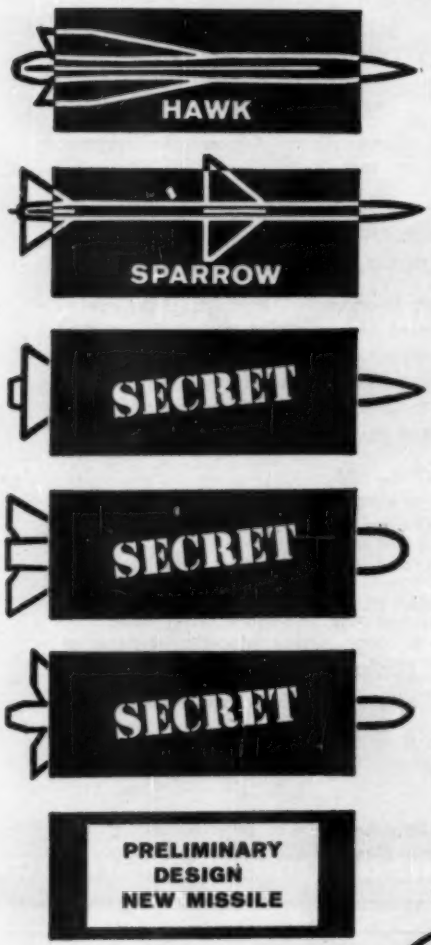
Gentlemen:
I am interested in the possibility of an association with the Jet Engine Dept. of General Electric.

Name_____
Address_____
City_____ Zone___ State_____ Phone_____
Degrees_____ College_____ Date_____

Be sure to Check Your Field of Interest Above. AW-4-28

GENERAL ELECTRIC
JET ENGINE DEPARTMENT CINCINNATI 15, OHIO

WORK IN RAYTHEON'S
EXPANDING
Missile Program



As one of the largest and fastest growing companies engaged in missile work, Raytheon offers unusual opportunities for challenging assignments to:

AERONAUTICAL, ELECTRONIC AND MECHANICAL ENGINEERS

Continued expansion of our development programs and advanced missile design projects offers outstanding opportunities at all levels to experienced engineers desiring assignment in these fields:

SYSTEMS
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MICROWAVE
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APPLICATIONS
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AERODYNAMICS (Missile)
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Performance
Air loads

WIND TUNNEL TESTING

AERODYNAMIC HEATING

ROCKET ENGINEERING (Solid)

Consider these overall benefits at Raytheon:

- High starting salary.
- Excellent advancement opportunity.
- Modern facilities.
- Suburban New England living, ½ hour from Boston.
- Educational opportunities at M.I.T., Harvard, etc.

For interview at our suburban laboratory in Bedford, Mass., write, wire, or telephone collect to CRestview 4-7100. Ask for J. Clive Enos.

RAYTHEON *MISSILE SYSTEMS DIVISION*

RAYTHEON MANUFACTURING COMPANY, Bedford, Mass.

WHO'S WHERE

(Continued from page 23)

Changes

Capt. Walter B. Miller has been appointed head of the newly established Pacific Missile Range Directorate, headquarters at U. S. Naval Air Missile Test Center, Pt. Mugu, Calif. Capt. Miller will be assisted by **S. R. Radom**, Deputy Range Director (acting); **Cmdr. R. F. Frietag**, Range Planning and Development Officer; **Cmdr. A. W. Hayward**, Inland Range Coordinator; **Cmdr. F. P. Morrison**, Range Instrumentation Officer; **Cmdr. D. G. Woosley**, Range Operations Officer; **Cmdr. J. B. Mongogne**, Target Officer.

Maj. Gen. Harold W. Grant will succeed **Maj. Gen. Alvin L. Pachynski** as Director of Communications-Electronics, Headquarters, USAF, Washington, D. C.

Col. Norman L. Peterson has succeeded **Maj. Gen. Thomas S. Moorman, Jr.**, as Commander, USAF Air Weather Service, Andrews AFB, Md.

Air Vice-Marshal Walter Charles Sheen has been appointed Commander, Royal Air Force Staff, British Joint Services Mission, Washington, D. C., replacing **Air Vice-Marshal A. D. Selway.**

James C. Crawford, assistant vice president-properties and facilities, Trans World Airlines, Inc. **C. W. Cronin** succeeds Mr. Crawford as Atlantic Region director of properties.

Harold E. Francis, senior staff engineer, Chandler-Evans, division of Pratt & Whitney Co., West Hartford, Conn.

Westinghouse Electric Corp. has established its defense products headquarters in Washington, D. C., and the following have been appointed to the staff of Maj. Gen. Albert Boyd (USAF, ret.), vice president-defense products: **R. M. Wilson**, director-application engineering; **Dr. Patrick Conley**, technical director; **V. W. McMahill**, director-contract administration; E. W. Locke, staff assistant and military liaison; **H. E. Dralle**, weapon systems coordinator, non-defense divisions; **H. A. Gunther, Jr.**, director-customer requirements; **C. A. Willer**, group budget director.

George G. Brown, director-engineering operations, United States Testing Company, Inc., Hoboken, N. J.

Charles C. Silva, Jr., director of process engineering, Clevite Transistor Products, division of Clevite Corp., Waltham, Mass.

Willis L. Littleford and **Marvin R. Parker**, sales representatives, Republic Aviation Corp.'s Helicopter Division, Farmingdale, N. Y.

Dr. Lyman G. Bonner, director of development, Explosives Department, Hercules Powder Co., Wilmington, Dela. **Dr. L. G. Maury**, succeeds Dr. Bonner as manager, Explosives Research Division and High Pressure Laboratory of the company's Research Center.

F. E. Farris, assistant to the president, Data-Control Systems, Inc., Danbury, Conn.

Kenneth R. Eppele, laboratory director, Wyle Research Corp., El Segundo, Calif.

James A. Erdle, chief engineer, Johnson & Hoffman Manufacturing Corp., Mineola, N. Y.

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now open within advanced component programs, including stainless steel honeycomb structure, metal bonding and steel weldments. *Quarter-billion* backlog, over *50% commercial.* Experienced Aircraft Engineers are invited to forward resume at once to J. L. Hobel, Industrial Relations Manager, Rohr Aircraft Corporation, Chula Vista, California.
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Bids: May 20, 1958

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PUBLIC NOTICE IS HEREBY GIVEN that the University of Mississippi, University, Mississippi will sell at public bid opening to the highest bidder, in accordance with conditions in the detailed bid specifications, at 2:30 P.M. on May 20, 1958 at the University of Mississippi, two air planes, Model L13, 245 HP, air cooled Franklin engines. Property is located at the University of Mississippi Forest Lands near Wiggins, Mississippi. Security in form of certified check or bidders bond equal to ten per cent of total bid required.

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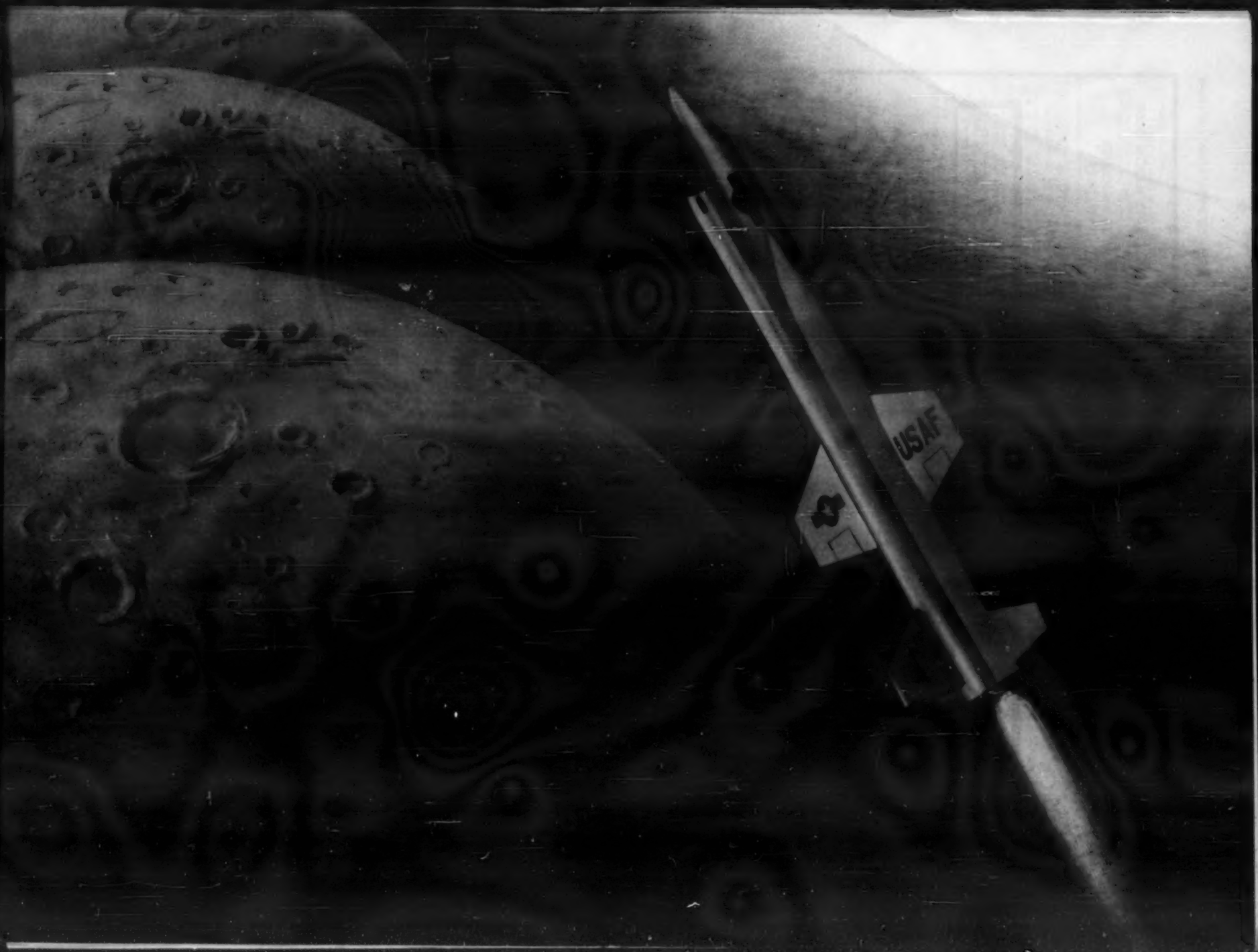
USAF

"Research for Space"

1958's big AVIATION WEEK editorial theme

June 16th marks the publication date of AVIATION WEEK's "Research for Space", 1958's most ambitious and dramatic editorial effort. Major areas of editorial attention: missiles, satellites, spacecraft, space probes, Dyna-Soar, avionics, exotic fuels and hypersonic aircraft, are presently engaging the attention of the world and exciting the imagination of scientific and military minds everywhere. The soaring national defense expenditures earmarked for national defense effort in these fields and general aviation procurement, amounting to some $10 billion scheduled to be expended in the second half of 1958, i. e. (January-June 1958) spotlight the timeliness of this issue.

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H. H. "HERM" COLE, at 39, typifies one of our many young "old timers", having joined the firm in 1942, just three years after it was founded. After varied experience in airplane design, Herm was assigned to the Preliminary Design Group of the XF-88 Voodoo in 1946 upon his return from Navy service. In 1952, he was appointed Assistant Project Engineer of equipment and structures on the F-101A, later being promoted to Project Engineer. Presently, he is Project Engineer for all three versions of the Voodoo.

The headlines of our nation's newspapers proclaimed the speed of the F-101 Voodoo after "Operation Fire Wall", conducted in late 1957. Herm's entire project organization deserves special accolades since it was the F-101A model of the Voodoo which established the new world's speed record of 1207 m.p.h. for operational fighters.

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LETTERS

Specified by Law

An article in the March 10 issue of AVIATION WEEK (p. 28), regarding the flight engineer-pilot dispute, should be reviewed with reference to the statement about the origin of the flight engineer.

While this statement is technically correct in that it is quoting an AFL-CIO report, it is none-the-less spreading incorrect propaganda which began with the ALPA itself. I am referring to the statement that "the third crew member was established by government regulation in 1948 . . . with the advent of larger, faster, more complex aircraft."

I do not believe that you would knowingly malign a minority group even to the extent of quoting someone else, and I believe that perhaps you do not know what the origin of the flight engineer was.

First, let me say that I have record of the flight engineers dating back to 1931. That is the seniority date (as a flight engineer) of the earliest flight engineer, presently flying with Pan American Airways. A large number of flight engineers flying today were active as flight engineers before 1948, or even before 1940. The year 1948, in which the ALPA is taking credit for creating the flight engineer, is the year that the Civil Aeronautics Administration recognized that civil air transport aircraft had become large and complicated to the extent that the flight engineer should be required by law; some airlines were not using flight engineers even though others had been for some time. Such a law was written, requiring a flight engineer on all large air transports, defining who the engineer was, and specifying his duties. This law is in effect today.

To set the record straight—the third crew member is not specified by law—the flight engineer is. 1948 was not the year the flight engineer's position was established. We have records of flight engineer in 1931. The "third crew member" is a term drawn up by the ALPA in an effort to secure the flight engineer's position for the ALPA members. The definition of flight engineer in the Civil Air Regulations is clear and makes no mention of the "third crew member."

I intend to bring this error to the attention of the AFL-CIO committee, and I hope that you and they will resist further efforts of the ALPA to get you to help them malign the flight engineering profession and the Flight Engineers International Assn.

E. S. KUMP
Santa Clara, Calif.

EAL Pilot List

Re your issue dated Jan. 20, p. 47, Airline Observer states: "Eastern (Air Lines) employs 1,465 pilots, American 1,541."

This is in error, as my husband's current seniority list indicates 1,790 pilots employed by Eastern.

AUDREY R. PHILIPPE
Glen Rock, N. J.

(Our error. Mrs. Philippe is correct; Eastern Air Lines does employ 1,790.—Ed.)

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine"s editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Pilot's Union

I have been a subscriber to AVIATION WEEK for over 10 years and consider it the finest periodical in the trade. I read each issue from cover to cover, and have always taken particular interest in your "Letters" section. I have just read your March 17 issue and couldn't get to a typewriter fast enough to reply to the letter "Captains' Union . . ." (p. 98) sent in by a Radio Operator from Reseda, Calif.

I am a copilot with Western Air Lines, a member of ALPA, and a past copilot representative of my local council. In the latter capacity, I was a member of the Board of Directors of ALPA, the governing body of the association. As such, I feel qualified to answer his letter.

This gentleman has made some very bitter and serious allegations against the Air Line Pilot's Assn. His statements show an amazing lack of information, not only about the inner workings of our association but also regarding the present dispute between ALPA and the Flight Engineers International Assn. Most of his comments are too ridiculous to dignify with an answer. However, I would like to set the record straight on the following:

1. Captains have never attempted to raise their salaries at the expense of any other crew member. As a matter of record, it was largely through the efforts of captains in 1951 that all airline copilots received an approximate 50% increase in pay.

2. Copilots have a vote equal to a captain in all association affairs. No copilot has been downgraded or otherwise reprimanded as a result of exercising his democratic right to speak at any ALPA meeting.

3. The ALPA is constitutionally opposed to the closed shop principle. To the best of my knowledge, no pilot has been discharged because of his failure to join the Pilot's Assn.

In closing, I seriously wonder if you check out any of the statements made by contributors to your "Letters" section. It is understandable that you do not attempt to edit any letters, and on a few occasions you reprint letters that misrepresent the facts in the area of certain mechanical features, specifications, etc. However, with particular emphasis on the problems as they exist between the ALPA and the FEIA, a small amount of research would have shown that the Radio Operator from Reseda was not exactly telling the truth and that to print his letter would only serve to increase the bitterness between the parties involved.

JACK L. KEYES
Los Angeles, Calif.

Teenage Rocketeers

You are undoubtedly familiar with the activities of tomorrow's rocket scientists, today's teen-age rocket experimenters. They build and test fire these missiles with some amazing results.

I understand some have exceeded 10,000 ft. The free world's future lies in their hands and I'm for them 100%.

One thing bothers me and that is where and when these missiles are fired. No one seems to have given this any thought. These missiles are potentially very dangerous to air traffic.

I think CAA should exercise some control over these firings, see that they are off airways and that ATC is advised. If some control is not exercised soon someone will be shot down. It may be a "Cub" with one person or an airliner with 100 persons aboard. Let's not let it happen!

TWA FLIGHT ENGINEER

Release from Details

I would like to enlarge on a point brought out by Milton E. Rice (AW, Feb. 10, p. 126) concerning the "engineering shortage."

I am a high school graduate with a background of mathematics, physics and chemistry. Postgraduate studies include "Diesel Engine Maintenance", "Mechanical Drafting", "Aircraft Machinist", "Sheet Metal Layout", "Advanced Aircraft Blueprint Reading" and "Riveting and Sheet Metal Assembly."

I have five years experience as an aircraft mechanic (structural) and spent 18 months as a draftsman in the old Army Air Corps.

Most recently I landed a job as draftsman with a small outfit doing subcontract work for the larger aircraft firms on Long Island. I handled same competently, but, as you know, the bottom fell out on Long Island six months ago. I am quite familiar with aircraft drawing techniques and "AN" hardware numbering.

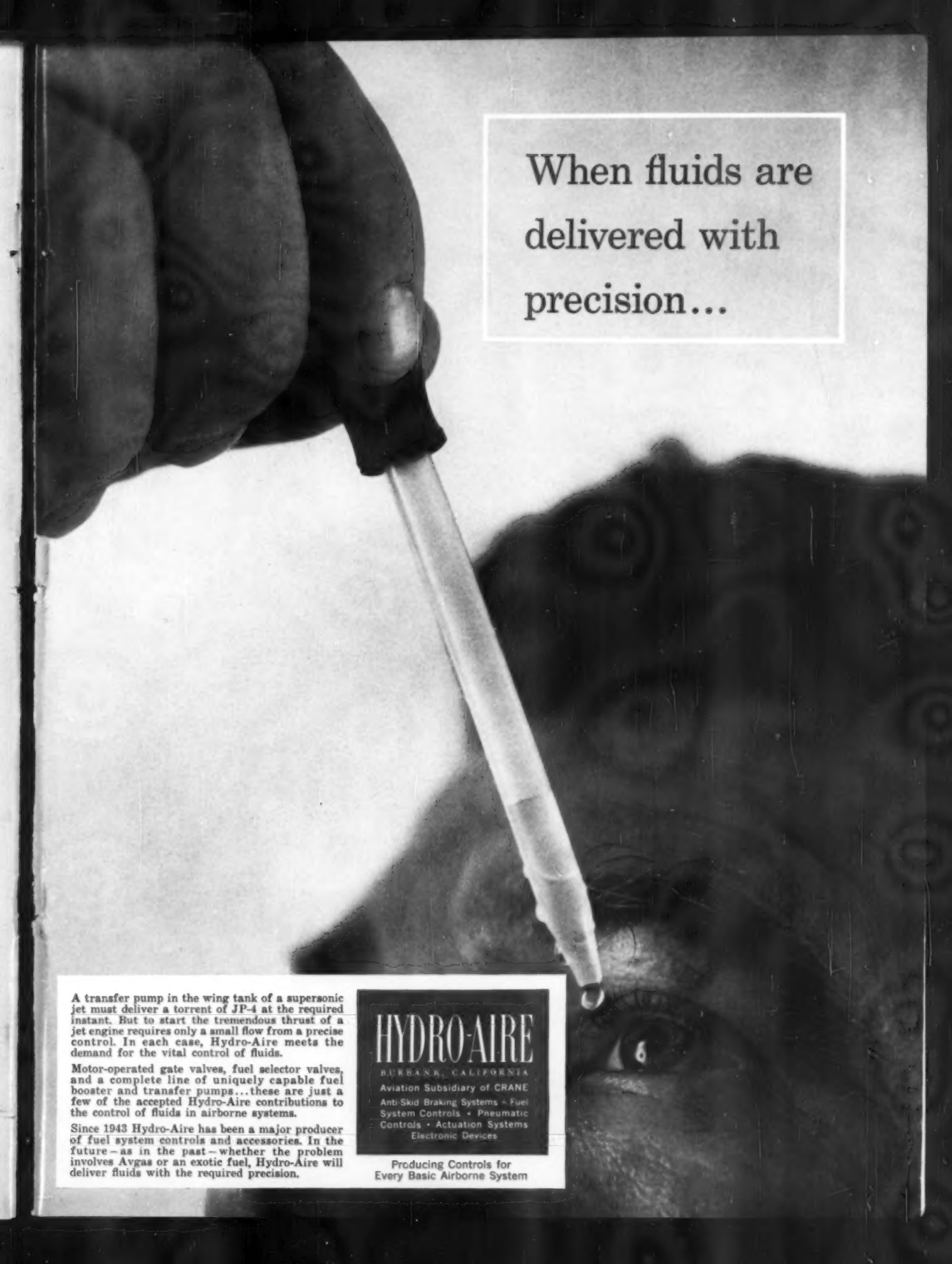
My point is that I am qualified to release an engineer or two from "detail or routine work" so that he may work to his capacity. In reality, I have been turned down by a score of firms due to lack of background.

Witness the want ads in N. Y. newspapers. Aircraft firms (country-wide) do not call for draftsmen; they specifically demand engineers. It stands to reason that a large part of these engineers will be used for detail work which can be handled by thousands like me who are ready, willing and able.

JOHN L. PFANN
(Unemployed Draftsman)
7511 66th Drive
Middle Village 79, L. I., N. Y.

P. S. Have worked for Republic, Fairchild and McDonnell as a mechanic, and REF Corp., Mineola, as a draftsman.

J. L. P.



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